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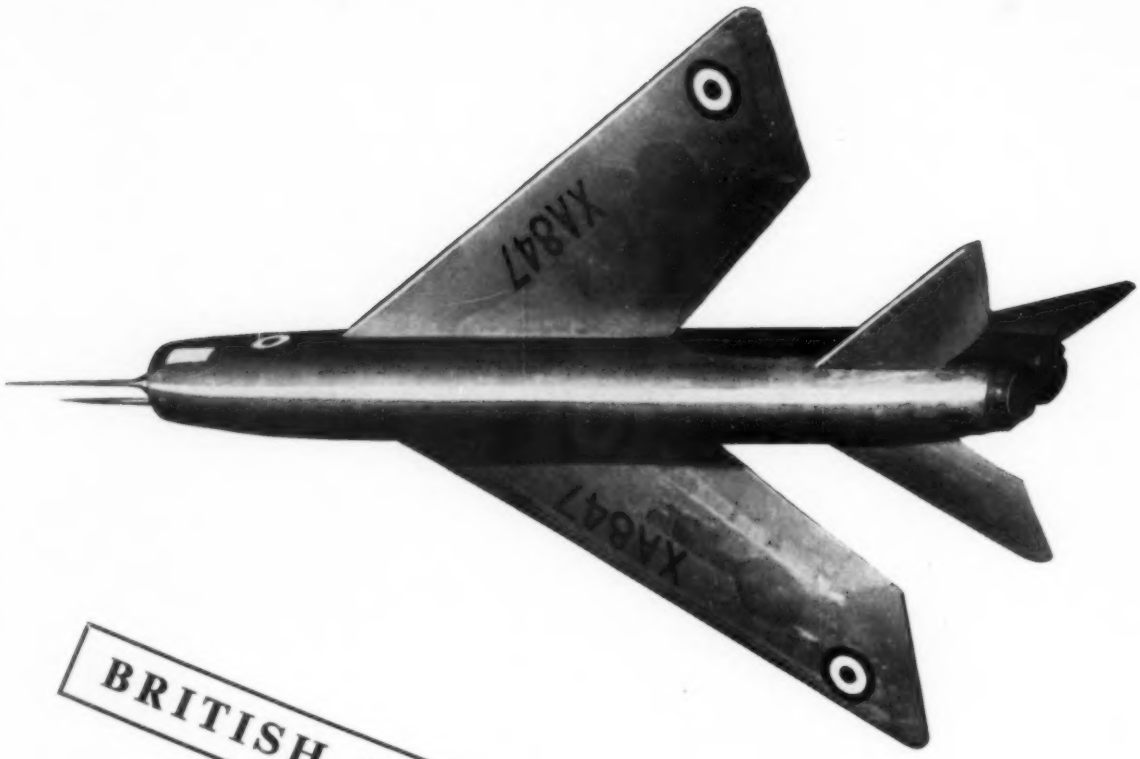


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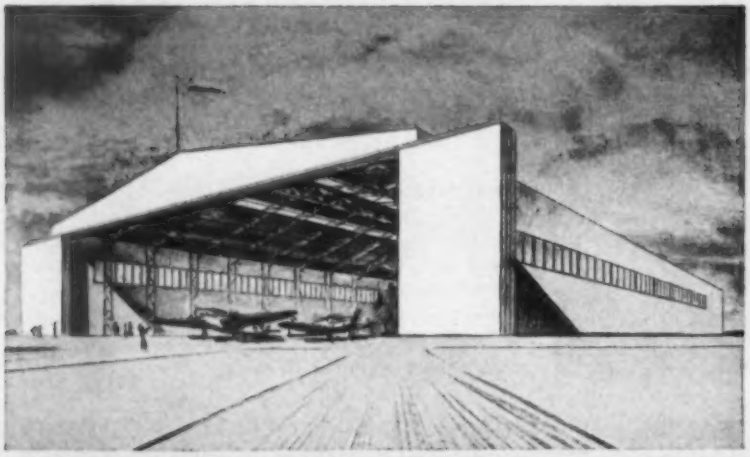

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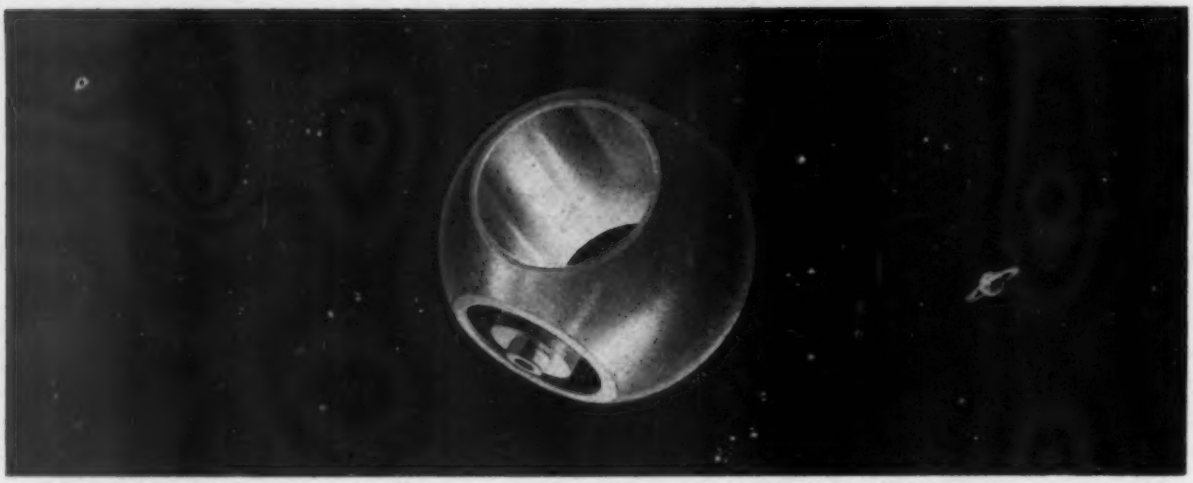

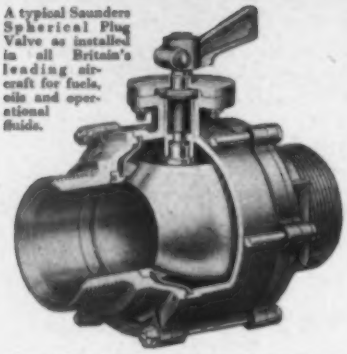

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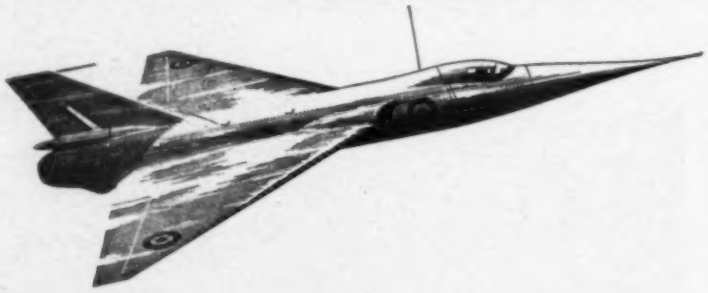

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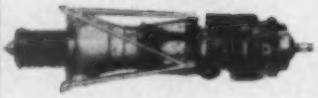

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and
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## Talent and Reward

"THE trouble with these fellows," said the apprentice supervisor, "is that as soon as they've completed their time with us they leave and get a better job." In such cases part of the blame can sometimes be laid at the door of the firm concerned; but the underlying problem of "how to hold a good man" is an intractable one.

For centuries one of the basic precepts of labour has been to sell oneself to the highest bidder. A good many people, of course, fairly soon get into a rut; but there are others who, for a variety of reasons, follow the move-on doctrine slavishly. One engineer in the profession which the Americans term "avionics" has to our personal knowledge changed his job seven times in ten years—and, perhaps as a direct result, now enjoys more than thrice his original salary. He has done well for himself; or has he? He will probably always be a drifter—albeit one who so far has gathered moss—and in this he is not untypical of many workers in new and expanding fields.

A good man is often individually sought after—but not always on his own merits; sometimes he is enticed from firm A to firm B because A is building an aeroplane or missile or motor car about which B would like to know more.

And now a new trend is apparent. In the past three years, and particularly in the U.S.A., an unprecedented number of able and ambitious scientists and engineers have formed companies of their own. Most of the basic groundwork in such fields as advanced fluid-control, cybernetics and nucleonics was accomplished by men employed by giant industrial corporations. Since 1955 such men have become increasingly difficult to hold. While many of them have been tenderly uprooted by their employers, and transplanted to new research centres amid verdant surroundings reminiscent of a college campus, hundreds of others have formed their own firms, specializing in one sophisticated line of business. They have chosen to live in such areas as Palo Alto, California, or St. Petersburg, Florida; and the visitor can tour such towns and count thriving new scientific businesses by the score. Their catalogues describe products which a year ago did not exist, and their presidents fear an economic slump as little as they do competition.

Comparable boffin-firms at Aberporth or Boscombe Down, or anywhere else in the United Kingdom, are conspicuous by their absence. Could it be that, in times like the present, the British engineer prefers to work for somebody else?

## Historic Wings

COMMITTEE discussions have been going on in the Air Ministry about setting up an R.A.F. aeronautical museum in the new wing which is now rising and will eventually be occupied in Whitehall Gardens. This project sounds admirable and it is to be hoped that nothing will impede its fulfilment. Famous aeroplanes (or examples of famous types) are already on view in various parts of the country—at the Science Museum and Imperial War Museum; preserved by the Shuttleworth Trust or the Royal Aeronautical Society; on the Royal Pier at Southampton; or standing monumentally at the gates of R.A.F. stations like Biggin Hill and Yatesbury. But so far the R.A.F. has never had a permanent collection of its historic machines on view, and this lack the new museum should help to supply, at an accessible spot in the heart of the capital.

It is appropriate that the proposed museum should be there, for another reason. Nearby, on the east side of Whitehall, is the Royal United Service Institution, which has for long done its best to represent the Navy, Army and Air Force with a fine display of models, uniforms, weapons and battle panoramas. Inevitably the R.A.F., being the newest Service, has had to take third place in this fascinating collection housed in all-too-limited space. The new museum on the Air Ministry's own premises—though itself necessarily limited in size owing to other demands on accommodation—will at least enable the R.A.F. to spread its historic wings a little. After all, when you are 40 and proud of it, there is much to be said for putting a few personal treasures on public view—especially when they are such popular ones as famous aeroplanes.

# FROM ALL QUARTERS

## Round-the-World Canberra

A CANBERRA P.R.7, *Aries V*, from the R.A.F. Flying College at Manby, took off from R.A.F. Manston at 0006 G.M.T. last Tuesday on a round-the-world flight starting with an eight-and-a-half hour non-stop leg of 4,189 miles to Nairobi in Kenya. No record is to be claimed for this flight, although its planned time is substantially less than the existing record—9 hr 55 min—set up by another R.A.F. Canberra (which refuelled in the Canal Zone) in 1952. At the same time as this flight of 28,340 miles a Canberra B.2, *Aries IV*, is to fly to New Zealand and back, being due to leave Strubby (Lincs) last Wednesday.

The objects of the exercise—code-named "Eastabout"—will be to practice and develop navigation techniques for use in areas where external aids are very limited, and to discuss operational and training matters with Commonwealth air forces. The round-the-world flight will be made entirely from Commonwealth airfields.

The crew of *Aries V* from England to Australia were G/C. J. E. S. Morton (captain), who is chief instructor at the R.A.F. Flying College, S/L. P. J. Lagesen and S/L. C. H. Parry; the aircraft is due to return to R.A.F. Strubby on May 14, when *Aries IV* is also due to arrive back there from New Zealand.

## Viscount's 500 m.p.h.

DURING recent performance trials a Vickers Viscount V.810 exceeded 500 m.p.h. in a shallow dive—nearly 140 m.p.h. faster than the speed at which the aircraft will normally cruise when in service. Mr. E. B. Trubshaw, deputy chief test pilot, reported that the speed was achieved at about 14,000ft after two previous shallow dives at higher altitudes. These particular tests were being made to check elevator and aileron responses in exceptional circumstances. First production V.810s should be delivered to America—for Continental Air Lines—this week.

## NATO'S Strike Fighter

THREE hurdles have to be crossed before a standard NATO military aircraft can begin to reach NATO squadrons. First, the technicians must decide which of the designs submitted is best; secondly, political conditions of standardization have to be settled; and thirdly, industrial arrangements have to be made for series production.

Following the meeting of NATO Defence Ministers in Rome earlier this month it appears that political agreement was reached on various points. In accordance with the technical opinions expressed after last year's evaluation at Brétigny, it was agreed that the Fiat G91 should be standardized as the first NATO lightweight strike fighter, followed after 1961 by a developed version of the Bréguet Taon. It was apparently also agreed that the Dassault Mirage III should be standardized as an intercepter.

The Defence Production Committee at NATO Headquarters near Paris is specifically charged with arranging the production of the Fiat G91, and decisions on this aspect are likely to be made at a meeting to be held on May 1. France, Germany, Italy and Turkey would receive the aircraft. Financing might be achieved by bilateral agreements between the countries and Fiat, with American support up to some 75 per cent. But American aid has been made conditional on France, Germany and Italy bearing a proportion of the cost, while G91s for Turkey would be wholly paid for by the U.S. The Defence Ministers are reported to have reached agreement on these points in Rome and to have decided that each country should now place an initial order for 50 G91s. For the future, there is a distinct possibility of a production agreement between Fiat and Bréguet for the Taon. Both G91 and Taon are powered by the Bristol Orpheus turbojet.

*TIGER BLUES: Two Grumman F11F-1 Tigers of the U.S. Navy's Blue Angels team present a "mirror image" act. On April 16 an F11F-1F Super Tiger, flown by Cdr. George Watkins, climbed to 76,828ft—subject to international ratification, a new world height record.*

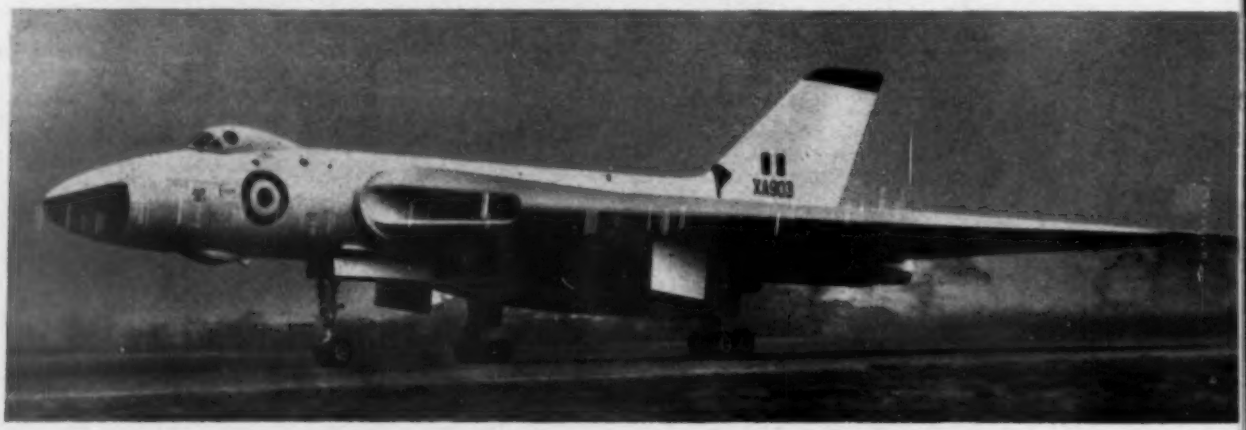
## Boulton Paul Directorship

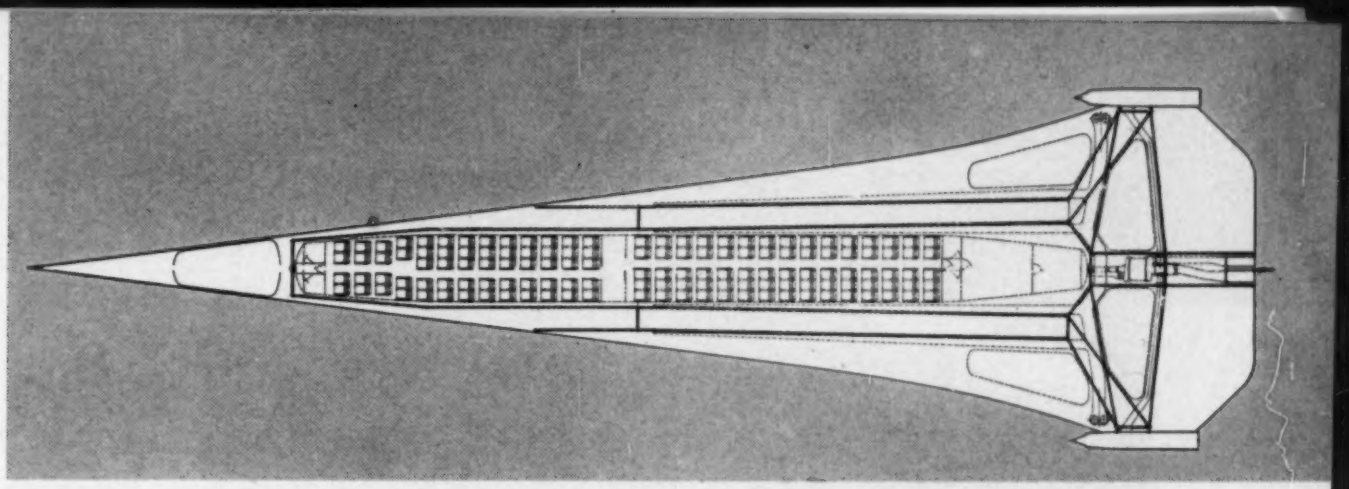
THE appointment of Sir Harold Roxbee Cox, Ph.D., D.I.C., D.Sc., M.I.Mech.E., to the Board of Boulton Paul Aircraft, Ltd., has recently been announced. Sir Harold, who also holds directorships in Wilmot Breeden (Holdings), Ltd., and the Brush Group, has had a long and distinguished career in engineering and aviation. From 1924 to 1929 he was at the Royal Airship Works, engaged in the construction of the R.101. During that period Boulton Paul Aircraft, Ltd., were also engaged in the design and construction of the hull frame for the airship, and Mr. J. D. North, the present chairman and managing director (then chief engineer and designer) was appointed consultant to the Director of Airship Development. Sir Harold in 1931 became Chief Technical Officer, Royal Airship Works.

*Sir Harold Roxbee Cox.*

His work has included valuable investigations between 1931 and 1935 into wing flutter and stability of structures, and among his many appointments have been those of Deputy Director of Scientific Research (1940-43) and Director of Special Projects (1943-44) at M.A.P.; chairman and managing director of Power Jets (Research and Development), Ltd. (1944-46); Director of the N.G.T.E. (1946-48); and Chief Scientist, Ministry of Fuel and Power (1948-54). He was knighted in 1953.

*VULCAN'S NEW HAMMER: The new Avro powered guided ("stand-off") bomb fitted for initial flight trials on a Vulcan B.1. This bomb will be a standard weapon in the armoury of the V-bomber force and will allow a wide choice of approaches to a given target.*





*GRIFFITH V.T.O. AIRLINER, subject of a lecture by Dr. C. T. Hewson, a review of which, by James Hay Stevens, begins on page 576 of this issue. The vertically mounted lift engines would have intake shutters in the upper surface and exhaust shutters in the lower surface. Propulsion engines would be rear-mounted, on the "flights" of the dart-like airframe. The crew would have a separate compartment in the nose.*

## A. Cdre. L. E. O. Charlton

WE regret to record that A. Cdre. L. E. O. Charlton, C.B., C.M.G., D.S.O., a former Air Attaché at the British Embassy in Washington and a prolific and provocative writer on the subject of air power, died in hospital at Hexham, Northumberland, on Saturday last (April 19) at the age of 78.

He became Air Attaché in 1919 after serving with the R.F.C. and R.A.F. in the First World War and prior to that with the Army, in the Boer War (when he won the D.S.O.) and subsequently in the Royal West African Frontier Force. From 1923 to 1924 he was Chief Staff Officer, Iraq Command, and he retired from the R.A.F. in 1928.

His books included *War Over England* (1936), which included an imaginative description of how 18 German bombers, taking advantage of a Hendon Air Display, destroyed nearly half the R.A.F. in ten minutes. *The Menace of the Clouds* contained a warning that "against air bombardment there is as yet no adequate defence"; and in 1938 he was one of three co-authors of *The Air Defence of Great Britain.*

# IN BRIEF

In a ceremony at Radlett on April 17, Mr. Frank O. Salisbury, the artist, presented to Sir Frederick Handley Page his well-known oil painting of Halifaxes under construction there in 1943.

* * *

Rotol, Ltd., state that Mr. L. S. Armandias, formerly deputy chairman of British Messier, Ltd., has "by mutual agreement" terminated his association with Rotol, Ltd., and with British Messier, Ltd., as from March 24.

* * *

W/C. R. F. Martin, chief test pilot of the Gloster Aircraft Co., Ltd., has approved the Finnish Valmet Vihuri advanced trainer—while recommending certain changes for winter use—after being asked to test it following accidents during the last four years.

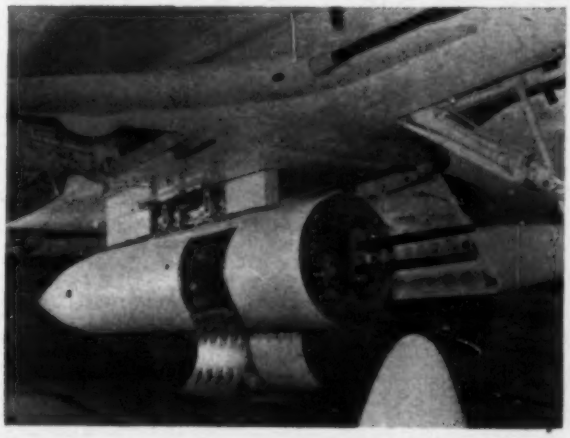
* * *

A Beechcraft F.50 Twin-Bonanza, intended for the personal use of King Hussein of Jordan, was delivered to Amman last month. The sale of the aircraft to the Jordan Army was negotiated by W. S. Shackleton, Ltd., and the machine was flown from Wichita to Jordan by Capt. R. G. Mayo, chief pilot of Ferry Service, Inc. This particular Twin-Bonanza has a five-seat cabin layout.

* * *

In the presence of the Duchess of Kent, who is president of the R.A.F. Benevolent Fund, the third R.A.F. Anniversary Concert took place last Friday at (for the first time) the Royal Festival Hall, London. The programme, by the Hallé Orchestra conducted by Sir John Barbirolli and the R.A.F. Central Band conducted by W/C. A. E. Sims, with Eileen Joyce as soloist, was obviously enjoyed by the audience—a capacity one, from which the Benevolent Fund should benefit accordingly. Among those present were Mr. C. I. Orr-Ewing, Under-Secretary of State for Air, and Marshal of the R.A.F. Sir Dermot Boyle, Chief of the Air Staff.

*WARLIKE STORES: Above are Martin Bullpup air-to-ground missiles (weight 540 lb, propulsion by solid rocket) with their launching vehicle, a North American Fury. Immediately below is the new Mk 11, two-barrel, podded, ground-attack gun, developed by Howard Hughes, on a Douglas Skyhawk. The Mk 11 has a very high, variable rate of fire.*



*ENTERPRISE: On page 583 we discuss the new Bermuda venture of Eagle, the British independent. Seen here last Sunday morning at Blackbushe, just before leaving for Bermuda, is the associate Bermuda company's first Viscount 805. Among those on board were Capt. W. F. Williams (uniform), who will supervise operations in Bermuda, and Mr. Harold Bamberg, chairman of the Eagle companies (fourth from left). Services to New York will start next Friday, May 2.*

"Flight" photograph

# 1958

## Russian Aircraft at the Universal and International Exhibition

By A. T. PUGH

UNDER the crowning colossus of the atomium, the great Brussels exhibition of 1958 sprawls over 500 acres of Belgian woodland. Nothing quite like it has been seen in Europe before, and the fair surpasses the great exhibition held in New York in 1939. The first impact upon the mind and eye is immense, overpowering, almost stupefying. Experiments in architecture crowd upon the mind until one's conception of the norm has gone; constructional convention is defied on every hand. It is a magnificent, wonderful show.

There is plenty of meat, within those towering pavilions and under the soaring spans of steel and concrete, for the aeronautical engineer. Rich red meat some of it is too, with information available for the first time on several aircraft upon which only scanty data has hitherto been published. Most British visitors will, I suppose, visit the British pavilion, as I did during a rapid visit last week, to satisfy themselves that our own aircraft industry is well represented. It is, or at least the engine manufacturers are, with show engines displayed by Bristol (Olympus), Rolls-Royce (Avon, Conway, Dart, Tyne) and Napier, whose Gazelle is shown mounted upright to drive attenuated helicopter blades in a representative installation. B.O.A.C. and B.E.A. are displaying a fine model of the Comet mounted high up on their impressive display.

But it is to the enormous Russian pavilion that visitors will gravitate eventually, for very few of us indeed have had opportunity of studying Russia's aeronautical offerings at first hand. And here, displayed in the great rectangular hall that dwarfs even the exhibits of heavy machinery, and flanking a great bronze of Lenin, are wonderful models of Russia's formidable civil fleet.

First to catch my eye was a model of the An-16, apparently identical with that of the An-10 opposite, although obviously with more seats and a slightly less elaborate interior layout. By this time my absorbed interest had been noticed by a Russian interpreter, but as we needed a third party to reconcile his German with my *lingua franca*, we made little progress other than the exchange of a pencilled note that An-10A = 100 man, An-16 = 130 man. Later a French-speaking interpretress joined in with further explanations. This was rather better, and I learned a little more about the accommodation arrangements in the Tu-114 and Tu-110. Then a third informant, Mr. N. S. Rybko of the Soviet Chamber of Trade, weighed in with some really helpful explanations in English. Mr. Rybko, overalled for this moving-in day, was very well informed upon most matters relating to Russian civil aviation, and I spent an intensely interesting and valuable few hours with him. I confirmed the impression that Russian civil aircraft manufacturers maintain a close watch upon the activities of their British and American contemporaries; perhaps they are a little envious of the co-operation that exists in the Western world—through the medium of exchange papers and Anglo-American conferences—on many basic problems. I was to be reminded of this again when I saw references to "fail safe" structures in a description of the Il-18 Moscow.

For his part, I think Mr. Rybko was interested in my reaction to Russia's formidable civil air fleet. I could not have disguised, in any case, my admiration for the quite magnificent Tu-114. Not a great deal of new information was available upon this as yet very new prototype, but the sectioned model showing a 170-seat interior is very similar to that depicted in the cut-away drawing on pages 286-287 of *Flight* for February 28. The 170-seat layout includes tables—each equipped with a shaded tablelight—for the alternate forward- and aft-facing seats in the central (restaurant) cabin. By removing these tables and using six-abreast seating, the accommodation can be increased to 220, although the general seat pitch of 36.6in may also suffer. From behind the aircrew compartment the accommodation is arranged as follows: a vestibule compartment with seats for the stewardesses (of which there are three) or for passengers waiting to use the toilet; the forward cabin with 41 seats; the restaurant cabin with 48 seats; a cabin with three forward-facing seats opposite the staircase; four pullman compartments seating 24 and an after cabin seating 54.

The backs of the three-abreast and two-abreast seats can be inclined from 16 to 40 deg and locked in any of seven positions; the recline angle of the cushion is 12 deg. The interpreters were adamant that there would be no seat price distinction.

Downstairs is the kitchen, in which are employed two or three full-time cooks; the food is despatched by lifts to the stewardesses for distribution. I had some discussion with Mr. Rybko as to whether the serving compartment should, in the circumstances, be called a pantry or a galley. I think we decided that pantry was the more appropriate.

Within the gross pressurized volume of 20,122 cu ft are two underfloor freight holds; most unusually (at least by Western standards) the after one can be entered in flight through a door on the lower deck. Perhaps provisions will be stored in the "cupboard under the stairs." There is plenty of room; the total volume is 2,472 cu ft, and the volume of the pressure cabin 16,423 cu ft. The cabin altitude incidentally is held at s.l. equivalent up to about 20,000ft and at an equivalent altitude of 8,000ft above that. The maximum differential pressure is 8.4 lb/sq ft. Temperature is held at 20 deg C and humidity at 20 per cent.

From the latest Russian turboprop we moved on to discuss the newest Russian jet, the Tu-110. I excited no sharp reaction to my questioning on the French refusal to allow the Tu-104 into Orly, or the possibility that the noise problem would restrict Aeroflot's Moscow - London service to the Il-18, which is expected to go into service in the summer (ten or more are now flying). My Russian informant remarked that there was still much to learn, and I like to think that his attitude is typical. In any case, he explained, silencers for the Tu-104 and Tu-110, similar to those used by de Havilland and Boeing, were now being developed.

The Tu-110, which is some 10ft longer than the Tu-104, is equipped with 100 seats and furnished according to the *ancien régime;* stained or natural wood veneers, gilded capitols and glass-fronted cupboards. "Why," I asked, "did Aeroflot have this divergence of opinion about interior design?" The answer was

*Russian aeronautical exhibits were, mainly, sectioned accommodation models of their civil fleet such as (left) the Il-18 and (right) Tu-110.*

unexpected; apparently Mr. Tupolev prefers the "club smoking room" style. Messrs. Illyushin and Antonov, on the other hand, are modernists, and civil aircraft are furnished to the manufacturer's and not to Aeroflot's choice.

From the Tu-110 we moved on to discuss Aeroflot's turboprops, the Il-18 Moscow, the An-10A Ukraine, and the An-16. The last, as recorded earlier, is simply a stretched (by three metres, 9.8ft) version of the An-10A which seats 130 and is slightly modified to give an underfloor cargo hold height of almost 4ft.

Both Antonov designs—once again, about 10 or 15 An-10As are flying—are intended primarily for domestic operations. They are equipped with double-slotted flaps and have a remarkable short-field performance, as the tabulated figures at the end of this article indicate. The mainwheel tyre pressure is 80-95 lb/sq in. The aircraft are intended for use over stage-lengths of 300 to 1,900 miles, and cruise at 370 to 400 m.p.h.—a performance obtained from four Ivchenco AI-20 turboprops of 4,000 e.h.p. each driving 14.8ft diameter propellers. The An-10A is claimed to be able to maintain height on two engines at over 16,000ft.

Other details of this turboprop pair were apparent from the models. The pilots' seats are mounted on high pedestals, with a considerable step up from floor level. A third crew-seat is in a deep well behind the pilots and reached by a two-step companion way from the cabin bulkhead door into the crew compartment. The navigator occupies a seat in the glazed nose, which is adjustable fore and aft upon rails and swivels to allow its occupant to reach the radio equipment racks and radio console to port, or the navigation table and radar scanner to starboard.

Because of the likelihood of its early appearance on international routes, perhaps the most interesting models on show at Brussels were the 75- and 100-seat variants of the Il-18 Moscow. The aircraft is intended for routes such as Moscow - Irkutsk or Moscow - Delhi non-stop, and has a still-air range with 1½ hr fuel reserve of 3,100 st. miles, or 1,860 with the maximum payload of 30,900 lb. The Russians are particularly proud of the Moscow's disposable load to take-off weight ratio of over 50 per cent. The engines are Kusnetzov N.K.4 4,000 e.h.p. turboprops, driving AB-68B four-bladed propellers 13.7ft in diameter; and, like the An-10A, the Il-18 is claimed to be able to cruise at 16,000ft on two engines.

The fuselage structure is apparently conventional monocoque, pressurized to an equivalent altitude of sea level up to 17,000ft, 5,000ft at 26,000ft, and 7,800ft at a cruise altitude of 32,000ft; the maximum differential pressure is 7.1 lb/sq in. Air is supplied from compressor bleed for air conditioning and 30 changes per hour are made in the 8,830 cu ft cabin volume. The cabin doors measure 55in × 30in. There are three cargo holds: the compartment forward of the wing and aft of the wing each have a volume of 495 cu ft and there is a further unpressurized hold aft of the pressure bulkhead, measuring 600 cu ft. The cargo access doors measure 47in × 35in. A compartment for carry-on passenger baggage has a volume of 247 cu ft.

The wing is made in three parts, a centre section 72ft long and extension planes. The centre section is of three-spar construction with 47 ribs and a total of 36 stringers. The skin thickness varies from 5.0 mm to 2.0 mm. The outer wings have two spars which, with the 1.5 mm skins, form the boundary members of an integral tank. There are 18 ribs and 27 stringers. Fuel is also contained in flexible bag tanks in the centre section and the total capacity is 5,280 Imp gal, although another version with integral tanks in the centre section has a total fuel capacity of 5,940 Imp gal. Titanium sheeting (forming problems have largely been overcome) is used to shroud the jet-pipes and in the wheel wells.

The flying control system is straightforward. The rudder is equipped with a spring tab and trim tab and the elevator with a trim tab only. With one exception, all the new Russian civil aircraft use manual, aerodynamically-balanced surfaces. The exception is the Tu-114, which uses hydraulic boosters with proportional feel-back to the stick. Dural tube push-pull rods are used.

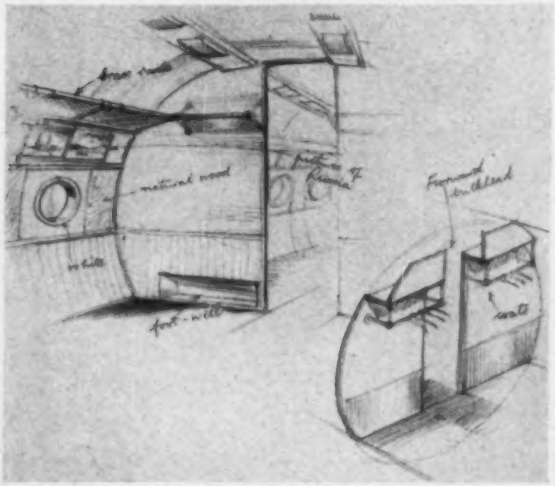
The undercarriage of the Il-18 is equipped with 900 mm × 285 mm tyres on the mainwheels and 700 mm × 250 mm on the twin nosewheels. The tyre pressure is 92.4 lb/sq in at 119,000 lb take-off weight.

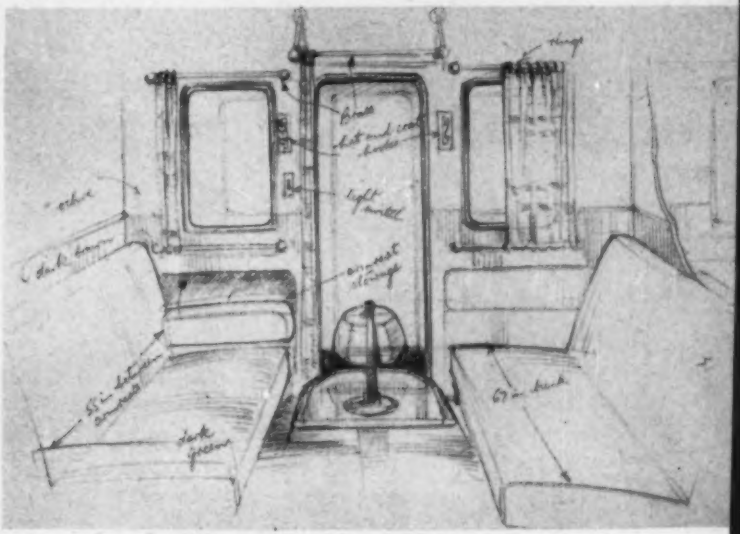
I discussed with Mr. Rybko the hydraulic fluid in Russian use. Their designation is AMY-10, which appears to correspond roughly with our own D.T.D.585; it is not a non-flam or water-based fluid. In the Il-18 hydraulic pressure is supplied by two NP-25 plunger-type pumps at a system pressure of 3,000 lb/sq in, and a flow of 8 gal/min. The system is backed with nitrogen-charged accumulators in steel bottles at 2,100 lb/sq in.

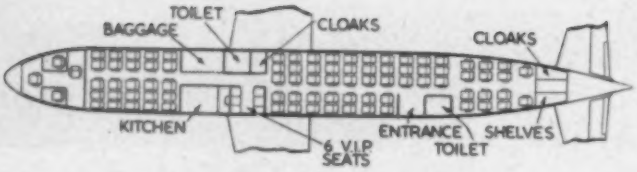
Electric power is supplied from eight 12 kVA variable-frequency alternators. Starter-generators are used, and these provide 28v D.C. current, 24v D.C. current being supplied by the batteries. Alternating current is required in quantity for the de-icing system which uses electro-conductive elements on the leading edges of the wings, fin, tailplane, propeller blades, spinners, engine intakes and windscreen. Although the models did not show black noses, the Moscow is equipped with cloud-and-collision-warning nose radar called *Emblema* that can be used for map-painting and for ground radar beacon identification. I was also told that a navigation computer was fitted that operated on pre-set co-ordinates—"just like Decca." The designation of this equipment is NI-50BM-3.

Electronics include H.F., two V.H.F., two A.D.F., radio altimeter, I.L.S., and marker beacon receivers. Quantitative data are given overleaf.

*Details of Russian airliners: (Left) Ingenious use of space characterises the design of the An-10A. There is plenty of storage space for 100 winter coats. (Right) Four of these unusual compartments are a feature of the Tu-114; they seat 24 or sleep eight.*



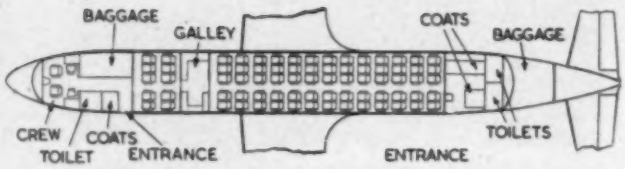



**An-10A***

**Dimensions:** span, 124.7ft; length, 121.3ft; height, 32.1ft; fuselage diameter, 13.4ft; wing area, 1,293 sq ft; cargo hold volume, 1,483 cu ft; passenger cabin volume, 7,840 cu ft.

**Weights:** take-off 121,500 lb; payload, 32,000 lb; wing loading, 88 lb/sq ft; power loading, 7.2 lb/sq ft; fuel wt, 22,600 lb.

**Performance:** max. speed at 26,250ft, 483 m.p.h.; range at 32,000ft with 1 hr fuel reserve (payload 32,000 lb), 1,240 miles; with payload 23,000 lb, 1,927 miles; with payload 18,600 lb, 2,127 miles; take-off run, 2,130ft-2,300ft; landing run, 2,130ft-2,300ft; landing run with reversing propellers, 1,640ft; rate of climb (s.l.), 1,960ft/min; s.l. climb with one engine out, 1,278ft/min; with two engines out, 472ft/min.




**Il-18 MOSCOW***

**Dimensions:** span, 122.7ft; length, 117ft; height, 33.4ft; wing area, 1,507 sq ft; aspect ratio, 10; wing section, 15.5 per cent root, 13 per cent tip.

**Weights:** *100-passenger version:* take-off, 119,000 lb; empty, 61,730 lb; payload, 30,860 lb; structure wt per passenger, 617 lb; wing loading, 79 lb/sq ft; power loading, 7.5 lb/e.h.p.; fuel capacity, 3,210 gal. *Seventy-five-passenger version:* take-off, 127,870 lb; empty, 61,730 lb; payload, 26,450 lb; structure wt per passenger, 824 lb; wing loading, 84.9 lb/sq ft; power loading, 7.93 lb/e.h.p.; fuel capacity, 5,280 gal.

**Performance:** cruising speed, 403 m.p.h., at 26,250ft; range with 1 hr fuel reserve, 1,860 miles; take-off distance, 2,460ft to 2,950ft; landing distance, 1,640 to 1,970ft.

## BRUSSELS 1958 . . .

**Layout of the Il-18 Cockpit.** The Russian photograph reproduced below illustrates for the first time the cockpit layout of the Il-18 Moscow. Black instruments, in uncrowded and orderly array, are distributed on grey panels; and the ample windscreen sections, two of them electrically heated, offer excellent forward, sideways and upward visibility. Notable features in the fairly plain flight instruments are a turn-and-slip indicator calibrated in degrees of bank up to 45 deg for a speed of 500 km/hr, standard Western-type I.L.S. dial, logarithmic V.S.I. scales, miniaturized engine torque gauges, electric warning notices rather than plain red lights, and several dual-reading engine gauges.

Particularly notable are single-lever engine controls, and twin radar tubes (with brightness and focus controls) on a swivelling mounting, apparently serving search-type radar capable of using ground-based radar beacons. The autopilot, mounted below the ratchet-controlled throttle levers, has wheel and knob controls for all three axes, a warm-up setting and switches for gyros and heading lock. The flying control locking lever is next to the throttles. Beneath the co-pilot's flight panel separate dials show the position of each main undercarriage leg, a light panel shows undercarriage-lock positions; and there is a flap-position dial. Beside the captain's panel are two A.D.F. dials and what appears to be a spare artificial horizon, which possibly serves as a gyro vertical for the autopilot. A.D.F. control panels are in the roof. The central roof panel is for fire extinguishing and carries full instructions, a schematic diagram of the system and green lights to show fluid discharge.

Engine instruments, centrally located, include (left to right and downwards) two twin r.p.m. dials in per cent; two twin temperature-gauges; four miniature torque dials; two twin oil-pressure gauges; a fuel gauge reading to 12,000 litres; propeller setting and pitch-stop control selector, circuit breakers and warning lights; the second 12,000 litre fuel gauge; and four fuel-flow gauges reading up to 1,500 litres/hr on an outer scale and up to 6,000 on the inner scales. Propeller brake and reverse-pitch controls are to the left of the autopilot and speed governor switches set for 15,000 r.p.m. and 14,300 r.p.m. are to the right.

Undercarriage and flap controls are probably beyond the throttles, while radio, fuel system and pressurization controls will be on the long consoles outboard of each pilot. Access to their seats is round the outside, Stratocruiser-fashion. Toe pedals control the wheel brakes. The right-hand (and left-hand) windows probably pull in and slide back.

**Conversions from data displayed at the Exhibition*

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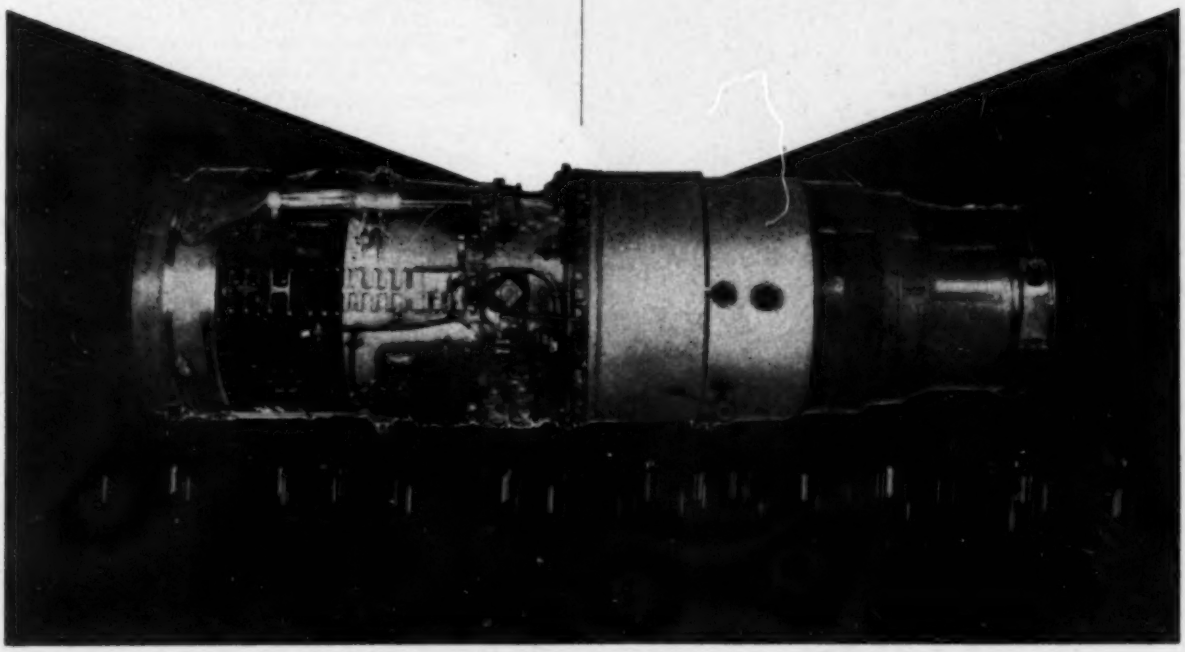

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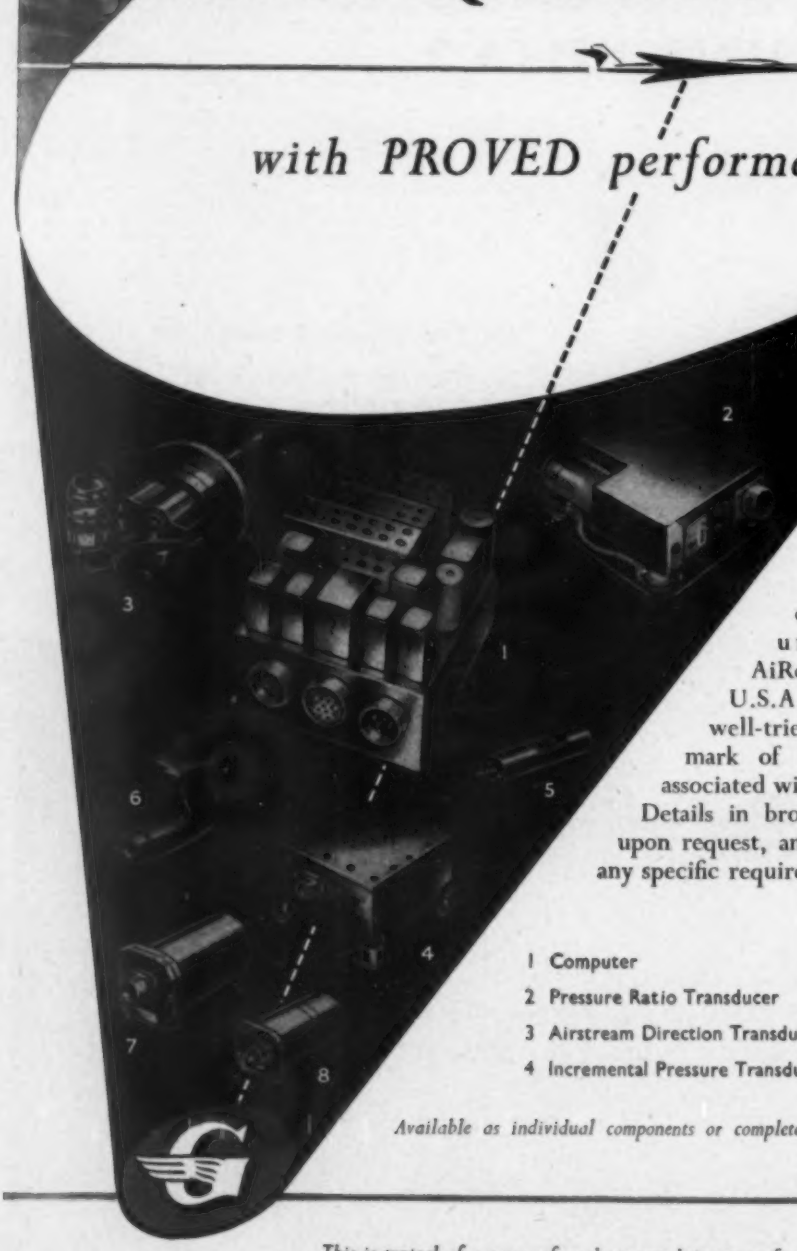


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# PROPELLER SAFETY

## *Precautions Against Malfunctioning of Engine, Propeller or Control Systems*

**THE development of aircraft propellers from the small fixed-pitch designs of the pioneers to the large variable-pitch constant-speed units of today has always been accompanied by the necessity to maintain and improve safety standards in the face of increasing mechanical complexity and structural loadings. This article, by a de Havilland Propellers engineer, reviews some of the problems involved in the design of propellers for high-speed turboprop installation, and describes the safety features incorporated in the latest D.H. propellers for the Rolls-Royce Tyne.**

IN the development of fixed-pitch propellers the question of safety could be confined to examination of the structural integrity of the design, but with variable-pitch propellers it becomes necessary to consider the effects of malfunction or failure of both engine and propeller-control mechanisms, as well as structural safety of the propeller itself.

The consequence of a failure in a variable-pitch system depends on the nature of the occurrence and the conditions obtaining at the time, but it is always possible to visualize circumstances in which such a propeller could operate as a windmill, thus giving rise to excessive rotational speed or large windmilling drag. Except for instantaneous structural failure of the propeller, with the consequent probability of damage to the aircraft, these are the two dangers most to be feared, since excessive r.p.m. may subsequently cause disintegration of engine or propeller, while excessive drag may, in extreme cases, render the aircraft uncontrollable or may alternatively necessitate a forced landing due to the reduction in aircraft performance.

The essential condition associated with such disastrous consequences is the assumption by the blades of a lower pitch than that appropriate to proper functioning of the engine/propeller combination at the given conditions. Thus the v.p. propeller, by its very nature, admits potential dangers of this type, and therefore merits unusual attention to all aspects of design affecting safety.

The structural design of a propeller is based upon widely accepted standards of permissible steady and vibratory stress-levels, considered in relation to short- and long-term operating conditions. A design is subsequently approved on the basis of tests which include subjection to loads considerably in excess of those to be applied in normal service. With this background it can be said that the possibility of major structural failure in normal service can be discounted. The designer must therefore concern himself with the provision of appropriate safeguards to ensure that malfunctioning of the propeller, engine or control system cannot result in loads being applied to the propeller which are outside the accepted design limit, or result in excessive loads being transmitted to the engine or aircraft.

**Characteristics of Windmilling Propeller.** It has already been stated that the principal dangers arising from the malfunction of a variable-pitch propeller are associated with windmilling. This is explained in Fig. 1, which shows vector diagrams for a typical blade element (a) in normal operation, and (b), (c) and (d) in a windmilling condition after engine failure. In case (a) the blade is shown to be operating at a small positive angle of incidence to the resultant direction of airstream upon it. The lift and drag forces on the blade resolve to give a thrust in the direction of flight, and a torque force opposing and absorbing the power delivered by the engine. In (b) the blade is shown at a lower pitch than that appropriate to the normal flight condition of (a), so that the angle of incidence of the blade element is now negative. The lift and drag forces on the element now resolve to give a net drag in the direction of flight, with a torque force tending to turn the engine in its normal direction of rotation. The propeller is now absorbing power from the airstream to assist in rotating the engine, instead of absorbing the power from the engine to produce thrust.

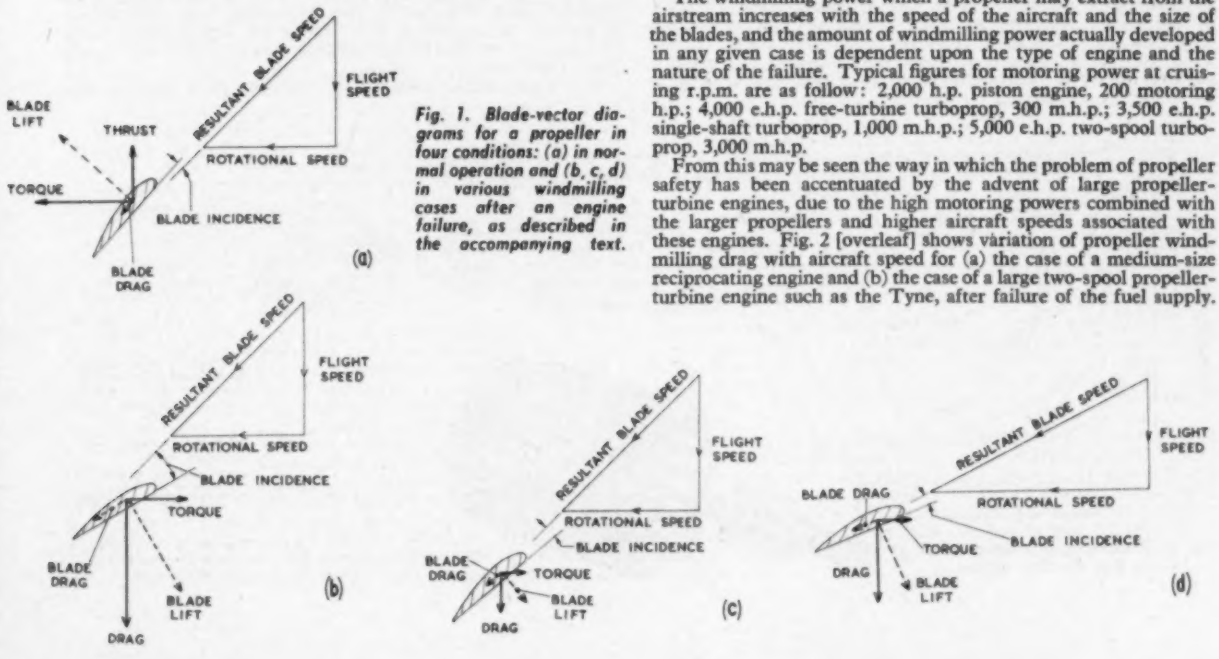



*Fig. 1. Blade-vector diagrams for a propeller in four conditions: (a) in normal operation and (b, c, d) in various windmilling cases after an engine failure, as described in the accompanying text.*

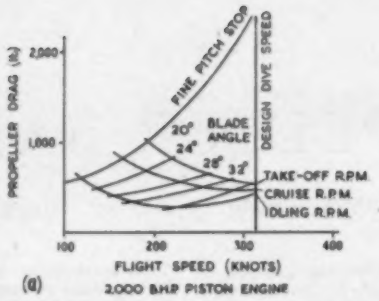
The exact shape of the vector diagram in a windmilling condition will depend upon the resistance of the failed engine to rotation. This resistance is known as the motoring power of the engine. If it is high as in the case of a large two-spool turboprop after a failure of the fuel supply has occurred, and if the propeller is still under the control of the constant-speed unit, the blades will be driven to take up a large negative angle of incidence in order to provide the windmilling torque necessary to maintain the governed r.p.m. dictated by the constant-speed unit. The drag will then be very large, as shown by the proportions of the vector diagram in (b). If the engine motoring power is low (as in the case of a free-turbine engine) or, alternatively, in the case of a reduction-gear failure which leaves the propeller shaft free from its coupling to the engine, a small negative angle of incidence suffices to provide the windmilling torque necessary to maintain the governed r.p.m. scheduled by the constant-speed unit. This case is illustrated in Fig. 1 (c), from which it may be seen that the drag will then be relatively small. If in such a case, however, the propeller is no longer under the control of the constant-speed unit, owing to some failure of that component or its drive, then in the absence of suitable safety features the blades will reduce pitch under the action of the centrifugal and aerodynamic forces imposed upon them, until this motion is arrested by the presence of a mechanical stop in the pitch-change mechanism.

This reduction in blade pitch at first creates a higher negative angle of incidence than that shown in Fig. 1 (c), thus causing the windmilling propeller to extract surplus power from the incident airstream and to accelerate itself to a much higher r.p.m. The system will eventually stabilize in the manner shown in Fig. 1 (d) with the blades on the fixed mechanical stop and producing sufficient windmilling power to rotate the assembly at very high r.p.m., possibly several times the normal take-off r.p.m. of the engine.

The windmilling power which a propeller may extract from the airstream increases with the speed of the aircraft and the size of the blades, and the amount of windmilling power actually developed in any given case is dependent upon the type of engine and the nature of the failure. Typical figures for motoring power at cruising r.p.m. are as follow: 2,000 h.p. piston engine, 200 motoring h.p.; 4,000 e.h.p. free-turbine turboprop, 300 m.h.p.; 3,500 e.h.p. single-shaft turboprop, 1,000 m.h.p.; 5,000 e.h.p. two-spool turboprop, 3,000 m.h.p.

From this may be seen the way in which the problem of propeller safety has been accentuated by the advent of large propeller-turbine engines, due to the high motoring powers combined with the larger propellers and higher aircraft speeds associated with these engines. Fig. 2 [overleaf] shows variation of propeller windmilling drag with aircraft speed for (a) the case of a medium-size reciprocating engine and (b) the case of a large two-spool propeller-turbine engine such as the Tyne, after failure of the fuel supply.

## PROPELLER SAFETY . . .



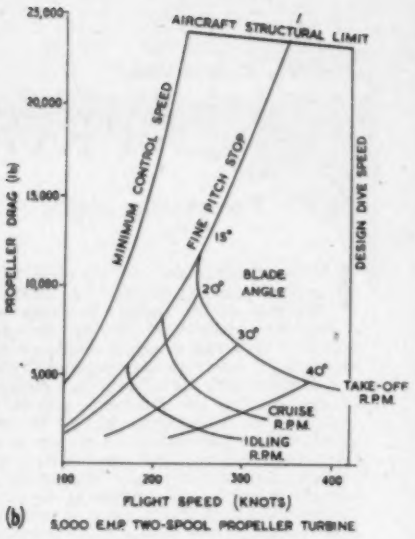




*Fig. 2. Variation of windmilling drag with aircraft speed for (a) medium-size piston engine and (b) large two-spool turboprop.*

In the event of failure of the fuel supply alone, the propeller control system would normally cause the blades to take up a pitch sufficiently low to maintain the pre-selected governed r.p.m. which may be that appropriate to take-off, cruise or flight idle depending on the part of the flight at which the failure occurred. In the event of an additional or related failure of the control system, and in the absence of any special safety features, it may be possible for the blades to reduce pitch down to the setting of a mechanical stop in the pitch-change mechanism. Fig. 2 (b) shows that the drag in this case may be very large indeed at high aircraft speeds.

**Safeguards against Excessive Drag and r.p.m.** The values of drag of the order shown on Fig. 2 (b) would, at best, severely penalize the performance of the aircraft, and may in some cases be sufficiently high to cause complete loss of control or structural failure of the aircraft, as shown by the typical limiting lines included on the diagram. Where a failure can give rise to conditions of this type, it is clearly essential to incorporate safeguards to prevent the assumption of an abnormally low pitch in any circumstances, whilst yet retaining the ability for the propeller to perform its normal function of automatic engine r.p.m. control over the whole speed range of the aircraft.

In the case of the piston-engine installation, protection is provided by the presence of the fine-pitch stop in the pitch-change mechanism, which is set at a blade angle just below the minimum value used in normal constant-speed operation of the propeller. This angle is normally determined by the take-off conditions of the engine/propeller combination, and is in the region of 15 deg to 25 deg.

The stop also serves as a positive barrier to inadvertent entry by the blades into reverse pitch, as the stop cannot be withdrawn except by deliberate action of the pilot after touch-down.

With increase of aircraft speed and engine motoring power resulting from the use of turbine engines, however, the flight fine-pitch stop no longer gives adequate protection against excessive drag as evidenced in Fig. 2 (b), nor is it possible to increase the blade angle setting of this fine pitch stop, or to introduce one or more additional stops set at a higher angle, without placing upon the pilot the additional burden of manual withdrawal of these stops at the correct time, simultaneously on all engines, to allow the propellers to continue their governing function in all flight conditions.

If stops set higher in the blade-angle range were used as a protective feature, failure to withdraw these stops at the appropriate flight condition would result in the propeller underspeeding, whilst inability to withdraw the stops, caused by a failure of the withdrawal system, would seriously affect the performance of the powerplant during final approach and landing, particularly in the event of a baulk necessitating rapid acceleration of the engines.

The system adopted by de Havilland Propellers in the design of the Tyne propeller to ensure the limitation of drag and r.p.m. following engine or propeller malfunction is, therefore, based upon the provision of means for immediate automatic detection of any failure, followed by quick remedial action to prevent dangerous conditions being attained. In this way the flight fine-pitch stop can be retained at a conventional setting to provide a positive barrier to inadvertent selection of braking pitch, while the entire range of blade angle used to maintain governed r.p.m. during flight is left unobstructed.

In order to give protection against excessive drag or r.p.m. the safety system must first sense the occurrence of a failure, and then prevent the assumption of an excessively low pitch by, if necessary, overriding the normal functions of the constant-speed unit. The dangers to be protected against are essentially drag and r.p.m.; it would therefore be logical to use signals based on these quantities for the failure-sensing system. In the case of overspeed detection this is in fact done, but in the case of the drag-limiting system it is inconvenient to derive a mechanical signal which is directly sensitive to drag. However, it has been noted that the amount of drag developed after a failure is dependent upon the negative or windmilling torque present in the system. An effective control of windmilling drag is therefore obtained if a limit is applied to the negative torque which can be developed in the propeller shaft, which thus provides the basis for a failure-detection mechanism for the prevention of excessive drag.

**Automatic Drag-limiting System.** Propeller drag-limiting systems based upon an engine torquemeter signal have been in service for some years.

Up to the present time the main purpose of the feature has been to provide automatic reduction of propeller drag after an engine failure at the critical point of the take-off, for which credit may usually be taken in the certification of the aircraft. In such installations, the system is set to operate at a low positive value of torque; should the torque in the shaft fall to this value, a valve is operated in the propeller controller which transfers all the incoming oil supply to the coarse-pitch line, thus feathering the propeller. Such a system must be cancelled at low throttle settings, since the normal torque transmitted by the engine shaft would then be similar to, or lower than, the torque setting of the safety system. To provide complete protection over the whole flight range for Tyne installations, this system has been extended by varying the torque setting with throttle position to maintain the setting at a value somewhat lower than that appropriate to normal engine operation.

The torque signal is transmitted from a movement of the annulus

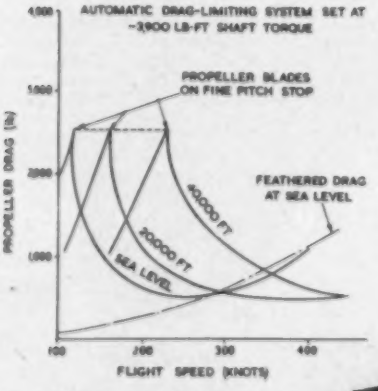
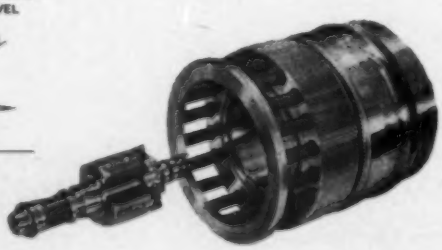
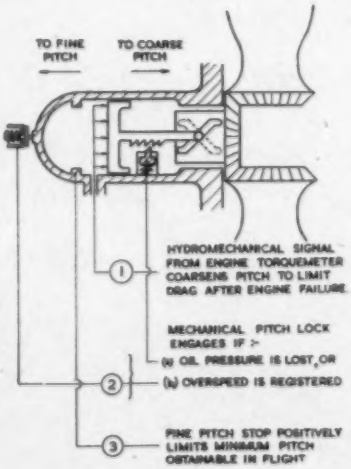



*Fig. 3. Response values for an automatic drag-limiting system.*

*Fig. 4 (right). Schematic diagram illustrating operation of mechanical pitch lock.*

*(Below) Part of the mechanical pitch lock assembly for the Tyne propeller, showing ratchet teeth which are forced into engagement by multiple springs following loss of oil pressure or overspeeding.*




TO FINE PITCH
TO COARSE PITCH
HYDROMECHANICAL SIGNAL FROM ENGINE TORQUEMETER COARSENS PITCH TO LIMIT DRAG AFTER ENGINE FAILURE
MECHANICAL PITCH LOCK ENGAGES IF :-
(a) OIL PRESSURE IS LOST, OR
(b) OVERSPEED IS REGISTERED
FINE PITCH STOP POSITIVELY LIMITS MINIMUM PITCH OBTAINABLE IN FLIGHT
1
2
3

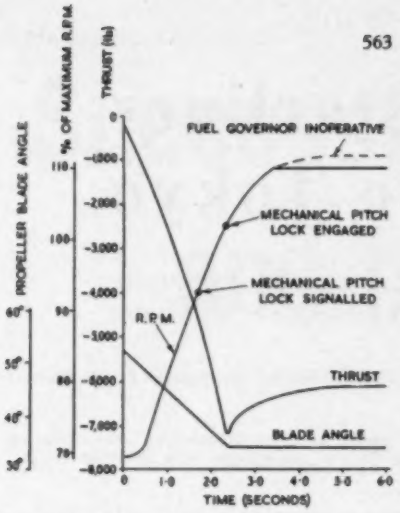



*Fig. 5. Behaviour of a propeller following failures in c.s.u. and drag-limiting system.*

*Most advanced de Havilland propeller is that for the 5,315 e.h.p. Rolls-Royce Tyne two-spool turboprop. This is the Tyne installation in the nose of a Lincoln test-bed.*

gear of the engine-reduction gearbox by a mechanical linkage to a servo valve in the propeller controller, which operates the coarse-pitching valve. It is to be noted that the independent electrically driven feathering pump is not brought into action by this automatic drag-limiting system, thus rendering the system entirely hydro-mechanical, and that the coarse-pitching valve is so positioned in the hydraulic circuit that it overrides any contrary signals that may exist in the constant-speed unit.

The response in terms of propeller drag is shown in Fig. 3. With the engine power lever in positions from low cruising power to take-off, the setting of the drag-limiting system is at a slightly positive value of torque. Thus in the event of engine failure in this range the propeller feathers. With the engine power lever at flight idle, the torque setting of the drag-limiting system is −3,900 lb-ft compared with a normal torque of −1,000 lb-ft delivered by the engine at flight idle. In the event of engine failure with the power lever in the flight idle position the engine torque will at first drop below the setting of the drag-limiting system, thus causing the blades to coarsen until a value of −3,900 lb-ft is restored. The blades will then continue to move to govern the torque to this value under the varying flight conditions. The drag is thus automatically limited to the values shown on Fig. 3, which may be compared with the unrestricted values given in Fig. 2 (b). Manual feathering can, of course, be accomplished at any convenient time to reduce the drag to an even lower value.

**Hydraulic and Mechanical Pitch Locks.** Although the automatic drag-limiting system provides a valuable first line of defence, it is clearly dependent upon the continued existence of oil supply to the propeller. It is therefore necessary to arrange for more positive protection against this failure. It is also desirable, in cases in which the unrestricted propeller drag or r.p.m. would be dangerously high, to provide protection against the occurrence of a contributory failure of the automatic drag-limiting system at the same time as a primary failure such as fuel supply failure.

One means by which protection is provided against loss of oil pressure is the hydraulic lock, which ensures that when pressure is lost the oil present in the fine-pitch side of the pitch-changing piston is trapped, thus arresting any further movement in the fine-pitch direction. This lock has been in use on de Havilland propellers exclusively for several years, and has proved its worth on a number of occasions. Due partly to the difficulty of checking the functioning of a hydraulic mechanism of this kind, however, the Tyne propeller also incorporates a mechanical pitch lock, which on engagement mechanically precludes any further movement of the blades towards fine pitch.

This lock consists of two rings of ratchet teeth mating in steps of approximately 2½ deg of blade angle, one attached to the rotating pitch-change cam and the other to the hub. The rotating ratchet is free to move axially on splines in the cam and is mechanically engaged by multiple springs, being held out of engagement by the normal operating pressure in the pitch-change mechanism. The lock is brought into engagement either directly by loss of oil pressure or through a signal indicating the existence of an overspeed. This signal is derived from an overspeed governor mounted on the propeller (in order that it may directly sense propeller r.p.m., and not engine r.p.m. in the event of a failure in the transmission between the propeller and the engine). When the propeller r.p.m. exceed the setting of the overspeed governor, the governor valve releases the oil pressure holding the lock out of engagement, thus allowing it to engage under the action of the peripheral springs.

It is clearly essential that the overspeed governor shall transmit its signal and engage the mechanical lock before the blades have moved to a low pitch, and it is therefore desirable that the operating setting of the governor shall be only slightly above the normal r.p.m. in use at the time. This condition is met on the Tyne propeller by providing two datum settings on the overspeed governor, the choice of setting being coupled with the engine power lever to ensure that the setting in use at any given time is that which is nearest to the normal operating r.p.m. at that time.

The change in datum from the low to the high setting of the overspeed governor is effected by bringing into operation a second governor spring by means of a servo-piston connected to a separate oil feed line in the engine shaft. When the engine throttle lever is advanced above the cruise position high pressure oil is fed to the servo-piston via this third oil line, thus bringing into operation the second governor spring and raising the governor datum. This feature also provides a method of checking the functioning of the pitch lock, for by providing a manual override it is possible to select the lower overspeed governor setting at a time when the propeller r.p.m. exceed this setting, thus causing the lock to be engaged. Indication to the pilot of the correct functioning of the lock is then provided by the fall in r.p.m. of the locked-pitch propeller occurring when the engine power is reduced by the use of the fuel-flow trim lever. The action of all these features is summarized in diagrammatic form in Fig. 4.

Fig. 5 shows the behaviour of the propeller in terms of thrust, blade angle, and r.p.m. following the primary failure of the control valve in the constant-speed unit, with a contributory failure of the automatic drag-limiting system. Detailed studies of the effect of various single and double failure cases involving the engine and propeller have shown that a failure of the constant-speed unit control valve in a manner which permits a continuous fine-pitch signal (e.g., seizure of the valve in the maximum fine-pitch delivery position) is potientially the most dangerous type of failure which can occur.

The combination of such a failure with an unrelated contributory failure of the automatic drag-limiting system may be claimed to be an extremely remote possibility, but is nevertheless considered here in order to illustrate that the mechanical pitch lock still prevents the occurrence of catastrophic drag or r.p.m., although permitting a higher order of drag than the very low values provided by the automatic drag-limiting system. In Fig. 5 the failure is assumed to occur at a true airspeed of 370 knots at sea level with the throttle in the flight-idle position (e.g., at the end of a long, fast descent). After 1½ sec the r.p.m. have risen to the setting of the overspeed governor, which signals the engagement of the mechanical pitch lock. The lock is engaged ½ sec later. With the blades locked at this angle, 18 deg finer than the initial operating angle, the engine cannot accelerate up to an r.p.m. greater than 10 per cent above normal maximum, with an associated drag of 5,900 lb.

The design of the safety features described in this article has been founded on a comprehensive series of analyses of the above type, covering various combinations of single and double failures of the powerplant and its control system. The inclusion of these features in the latest de Havilland propellers assures complete protection against the particular dangers associated with those failures of high-speed propeller-driving engines affecting the propeller system.

# Starliner to Tokyo

## AIR FRANCE INAUGURATES ITS "ROUTE POLAIRE" TO THE LAND OF THE RISING SUN

By RONALD BARKER ("Flight" photographs by the Author)

*An Air France news-sheet, "La Ligne Transpolaire" was circulated during the flight—a 10 a.m. photograph, with darkness outside.*

TIME and tide used to wait for no man. But whereas shipping lines still are the servants of tide, ambitious airlines are playing old Harry with time. Sometimes it has to slow down and wait for man to catch up with it, and sometimes he cracks on at such a pace that it has to take a short cut to keep up with him. However, neither man nor time can really afford to give the other the slip entirely, and would-be passengers over the polar routes have nothing to worry about on this score. After all, if you divide your life into lumps of 24 hours and calculate on your return home how many of those you have spent on your voyage, you *cannot* get home on the wrong day. And if you decide to remain in the East after crossing the Date Line, the sudden change of an intangible date will not affect your metabolism!

This jolly game was introduced last year, on a commercial scale, by S.A.S. with their flight over the polar regions from Copenhagen to Tokyo, via Anchorage in Alaska; now Air France, following delivery of all their new fleet of long-range Super Constellation L.1649As, have been able to follow suit from Paris. Until B.O.A.C. introduces its Comet 4s on the Far East route, this new Air France service will be advertised as the fastest commercial link between Europe and Japan.

With Air France you set off in evening darkness (if it's early April) at about 7.30 p.m. (1930 G.M.T.), watch the following day's sun rise twice and set once, and lose a day in the calendar before arriving in Japan after about 30 hours' flying time: and, as the last dawn had cracked for you some 13 hours earlier, it's somewhat disturbing to find that you have reached Tokyo at 11.30 a.m.

On the April 10 inaugural flight from Paris a distinguished passenger list included Air France's administrative president, M. Max Hymans; M. Gaston Monnerville, *President du Conseil de la République*, and other eminent French politicians. Journalists from France, Britain, America, Italy, Switzerland, Germany and Belgium also were on board.

Our small party from the U.K. was escorted to Paris via an Air France Super G Constellation by David Bamford, public relations officer of A.F.'s U.K. organization. His father has, of course, been its general manager since the early 'thirties. At Orly there was an informal send-off party before we were shepherded into F-BHBT *Frontenac*, the latest and last of the company's fleet of ten L.1649As. This aircraft had, in fact, been collected from Burbank only about a month previously by Commandant P. Wintersdorff, who captained our crew on the second leg of the journey—that is, from Anchorage in Alaska to Tokyo.

For this special flight the seating layout allowed everyone an abundance of space. There were 32 "Sky-lounges" (*fauteuils-couchettes*, the French call them) with retractable leg-rests arranged in pairs either side of the gangway in the main cabin, between the galley and the next bulkhead forward; 12 between that bulkhead (which contains the two toilets) and the crew's quarters. Aft of the galley were two double bunks topped by two singles, for the V.V.I.P.s on board.

On the later commercial flights there will be 34 tourist seats, 12 first-class Sky-lounges and eight Pullman berths. As with Air France Super Gs on other routes, the seats are trimmed in cloth of Shocking Pink—perhaps geranium pink sounds a little kinder, for it's a cheerful yet restful shade. Their sponge-rubber cushions and squabs are very comfortably profiled. Carpeting and seat-backs are in a sober grey, and the upper half of the cabin is trimmed in matt plastic material with a grey-and-white canvas print. The curtains are a gay, Picasso-like riot of pattern and colour.

There wasn't much fuss about getting our 70-ton liner airborne, despite its 8,170 Imp. gallon fuel load—which gives it a full range of over 6,000 miles. On take-off and for the first few minutes of the subsequent climb, vivid pale-blue flame licked from the twin exhaust-effluxes of the Wright Turbo-Compound R-3350 EA2s—the lower outlets from the engine cylinders, the upper from the triple exhaust turbines.

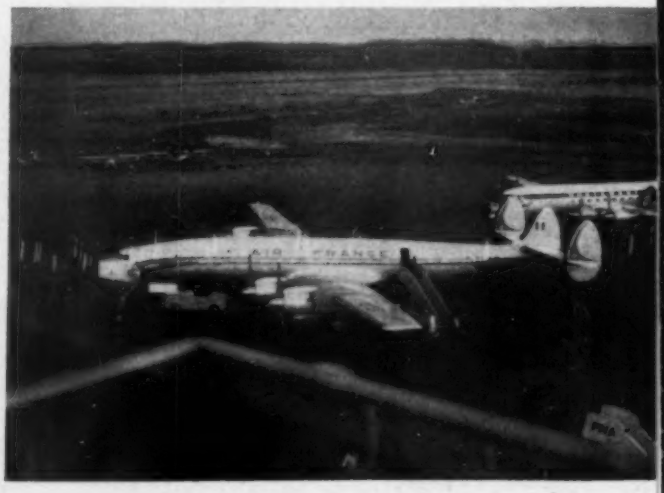
Soon the flame faded to salmon pink as the mixture was weakened and the engine speed cut, and thenceforth only a ring in the turbine outlet glowed red in the night. Cruising initially at 240 knots and about 9,000ft, we headed north over Belgium, then parallel with the East Anglian coastline and east of the Shetlands.

We had been reassured beforehand about the emergency equipment aboard—dinghies, tents, survival suits, plenty of concentrated foods, transmitters, stoves, rockets and smoke generators, torches, sun-glasses, and even a hunting-knife and a triple-bore rifle for potting at polar bears. Now a bilingual steward demonstrated life-jacket procedure; if we were dropped into the sea, we should be both phosphorescent and shark-proof.

Engine and propeller noise is quite subdued in most parts of this largest member of the Constellation family. The inboard motors are farther outboard than on the smaller craft, to use an Irishism; the huge, three-bladed props are geared down more, and there is added sound-damping in the fuselage. Only in those parts of the cabin nearest the blade-tips—in particular, the toilets, so that one is not inclined to stay in them longer than is necessary—is the noise and vibration at all oppressive.

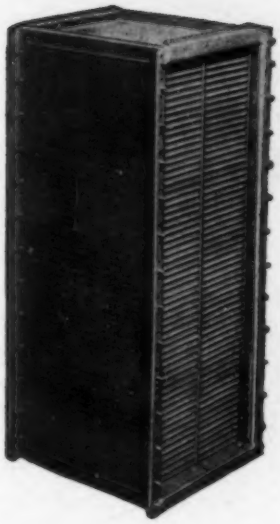
Our senses had already accustomed themselves to the hum and very slight movement of our temporary caravan when Air France began to serve their evening delights for the table. First, a wide choice of aperitifs; then, lubricated liberally with champagne and table wines, came a *Caviar de Béluga* with a fresh tang of the sea, cold turbot with salad, lamb chops with *haricot verts*, cheeses, *petits fours*, ice-cream (just about as we crossed the Arctic Circle N.E. of Iceland), fresh fruit, coffee and brandy. This light repast finished at about 0030 G.M.T. on the 11th.

It should have put everyone soundly to sleep for many hours, yet at 0220 G.M.T. I woke to see a bright and decorative sky to the N.E.—all the spectral shades over a black and empty sea. Was this a sunrise without a sun, or a sunset, or the aurora borealis? Or even



*F-BHBT "Frontenac" on the Anchorage tarmac soon after daybreak, as seen through the control tower windows.*

# Successful heat exchange and heat insulation



We design, manufacture and supply heat exchangers for many purposes in both aluminium alloy and stainless steel. This particular example is for the Vickers Viscount's anti-icing system. Similar units are supplied for the Fokker Friendship and the Bristol Britannia.

This thermal blanket is in refractory fibre cased in .004 inch (.1016 mm) stainless steel. It was made-to-measure and is extremely light, the dimpled construction being responsible for its great strength. Specified for Rolls-Royce and Armstrong Siddeley jet and turbo-prop engines. Approved by the A.R.B.

High pressure fuel-cooled oil cooler for high performance gas turbine engines. This unit is used in the Armstrong Siddeley Sapphire S.A.7.

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## STARLINER TO TOKYO . . .

*Hearty handshake for Paul-Emile Victor, famous polar explorer responsible for emergency equipment and crew training, after a speech at Anchorage. Under the third picture from the left is M. Max Hymans, Air France president.*

the champagne and just a dream? No one else seemed to know, but I think it might have been Friday's sun trying to reach us from somewhere around Siberia. At this time we were approaching the east coast of Greenland, which we crossed (0320 G.M.T.) at Jónsbú —about latitude 75 deg N. My special sunrise then disappeared.

The icy mass of Greenland was crossed, in darkness, diagonally from Jónsbú and over Kennedy Straight to Fort Conger on Ellesmere Island. Now Friday's sun began to rise, from the S.E. relative to our aircraft, so that we were able to pick out the forbidding peaks and glaciers of Grant Land in the twilight.

Between there and Barter Island on the mainland of Alaska there was a leisurely breakfast in full daylight, and Bertrand d'Astorg, who is a poet and author as well as being Air France's second string in public relations, entertained the guests by donning a survival suit and being dowsed with Perrier (see photograph) to celebrate our Arctic crossing. Our cruising speed had risen steadily as the aircraft became lighter and the flight plan in terms of progress and fuel consumption had proved fully satisfactory.

We were now at 24,000ft and cruising at some 295 kt. Outside our aluminium shell the air temperature was −56 deg F (88 deg of frost) but a ground temperature of +37 deg F was forecast at Anchorage—with good weather and clear skies. We were told, too, that our nearest approach to the Pole had been 870 km, at precisely 0638 G.M.T. After that we had started, of course, to drop down the other side of the world.

On this route there is the same independence of a fixed course as over the Atlantic. Depending upon the atmospheric pressure at the Pole and consequent wind directions and strengths, some flights may pass directly over it, whereas on other occasions it may be skirted by over 1,000 miles. On the return route from Tokyo more favourable winds prevail, and the flying time in this direction is quoted as 27½ hours in place of just under 30 for the outward trip —both fabulous figures for an 8,420-mile flight when considered in relation to the time it takes to cover that distance in a private car.

Polar flight and its relationship to the earth's rotation and the sun is most probably less obscure to most of my readers than it is to me—and many of my fellow-passengers. To put matters in their simplest terms (I *think*) the sun can be considered as rushing round the Equator at about 1,000 m.p.h. in a clockwise direction viewed from the North Pole. Thus from Paris to Tokyo one is being chased by it, and from Tokyo to Paris one is rotating in the opposite direction to meet it. On the westward journey, the higher the latitude, the slower one has to go to keep up with the sun; so at the Pole itself one wouldn't have to move at all—except to keep warm.

Initially from Paris we had, as it were, spent our time climbing up to high latitudes without making much impression westwards, or longitudinally. During this period the sun was overtaking us rapidly; but once we had reached northern regions of the globe where its horizontal periphery is much reduced, we were progressing quicker than the sun.

*(Right) Crossing-the-pole celebration: M. Bertrand d'Astorg of Air France has his survival suit proved impervious to Perrier water.*

Thus it was that our breakfast sun before Alaska disappeared again at around 0800 G.M.T. after only about three hours, and we re-entered the same night that we had so recently left. This was deeply disappointing, since we were thus deprived of a sight of Alaska's mighty mountain ranges, including the North American continent's highest peak—Mount McKinley (20,269ft). Just before midday G.M.T. Commandant Carmeille (who completed A.F.'s first proving flight over this route last January) throttled back, and we lost height gradually in increasingly bumpy conditions, for touch-down soon after midday at 1237 G.M.T.—still just in darkness.

This was fair enough for the Anchorites, for their local time was only 0237. Nevertheless, the whole city seemed to be there to welcome us, with words, music, food and drink. There were three combo bands taking turns to play the *Marseillaise*, the Alaska territorial Anthem: ". . . Alaska's flag—to Alaskans dear, The single flag of a last frontier." We were only disappointed that there was no Eskimo band to play us *phoque*-songs on their sealskin guitars. All had been arranged by the Chamber of Commerce Red Carpet Committee, and if one can make a friend in two hours, here was ample opportunity.

Colonel Don Graham, deputy commander of the U.S.A.F. 10th Air Division, told us something about flying activity and conditions in the district, military, private and corporate; and about the hard but rewarding country around there. The latest winner of the Fur Rendezvous Queen Contest helped to entertain the guests, and a monster stuffed timber wolf to frighten them. Whilst we were there an S.A.S. DC-7C on its polar path flew in, refuelled and was quickly away—routine stuff these days. A spectacular dawn, which had begun to glow behind the range of snow-covered Chugach mountains, provided a superb backcloth to our function. Just before we left, a local resident, one Eugene C. Smith, smuggled me into the control tower to enjoy a view of his home-town and surroundings. We looked over to Hood Lake, where ten per cent of the U.S.-registered floatplanes are kept. Hood Lake is joined to another by a canal, which gives an adequate take-off run for heavily laden craft. In fact, over 800 lightplanes of one sort and another are registered in the area—it claims to be the Small Plane Capital of the World.

Even this brief introduction to Anchorage whetted the appetite for more—especially as there was no snow around, and there had been only three wet days in the last sixty. Take-off was at 1527 G.M.T., and we were to remain in daylight, with the sun chasing us until that evening in Japan—20 hours or so of daylight in April. Our complete crew had changed at Anchorage (we had clapped the retiring members a friendly thank-you) to await *Frontenac's* return on the following Sunday (Japanese time), and we were now in the charge of Commandant P. Wintersdorff, with over 13,250 flying hours' experience logged.

Time now began to go really haywire. For instance, our last meal (breakfast) had been at 0830 G.M.T. and, apart from a bite or two during the reception at Anchorage International, we were not fed again for 12 hours, towards the end of which the charming and

*Cmdt. P. Wintersdorff studies the storm-warning radar picture. Other members of the slip-crew on the Anchorage-Tokyo section included 1st Off. Alphonse Calvel and Eng/Off. Georges Novion.*

*Dawn from the Anchorage control tower. The lake in the middle distance is one of two, linked by a canal, used by marine aircraft.*

## STARLINER TO TOKYO . . .

constantly attentive Air France stewardesses (one of whom was Japanese in each crew) were embarrassed to hear our entrails rattling in protest. The meal, when it came, was termed *déjeuner/dîner*—apéritif, tinned salmon and salad, braised chicken with mushrooms, cheese and an orange—plus an endless flood of champagne and/or wine. Meanwhile our friends at Anchorage were probably enjoying a late breakfast.

We had passed over the tundra and ice-bound lakes of Alaska at about 1650 G.M.T., but for a while the white, mountainous outline of the north-west corner remained in view. Then we were alone over the Bering Sea, roughly following the line of the Aleutian Islands, and our next glimpse of land would be Japan, many hours ahead.

At 1940 there was some excitement when the inboard port propeller feathered—rumours of overheating, surmise about the point-of-no-return. About 25 minutes later Cmdt. Wintersdorff restarted it, and it gave us no further anxiety. I went forward for a word with him a little later, and asked why he had stopped this engine. Apparently a warning light had flashed, and he had taken the step as a precaution, although rightly suspecting a faulty signal switch—it was still signalling whilst I was in the cockpit with him.

He was making frequent reference to his weather radar, the scanner of which has a 40- to 50-mile range and enables the pilot to foresee and avoid storm centres. Our altitude at this time was 14,000ft, and we were running a little slower into a medium headwind. Speaking with François Le Noan, the navigator, I learnt that two navigators have been carried on the first leg to Anchorage, but that only one is required on the briefer and less hazardous Anchorage - Tokyo stretch. Although the magnetic compass is useless in the polar region, it is apparently usable during the last three hours before the Anchorage refuelling stop on the outward run, and for the whole of the Anchorage - Tokyo section.

There are, however, six or seven hours during which a Bendix polar-path gyro compass is supplemented by several other aids. Incidentally, although two gyro compasses are carried in case of the failure of one, these instruments are considered sufficiently accurate for readings to be taken only from the one. A polarized sky light compass can plot the position of the sun during the arctic months of twilight, when it is well below the horizon and neither stars for astral navigation nor land are visible. In addition, there are plenty of radio signalling stations adjacent to the route; unfortunately, cosmic disturbances at these high latitudes cause much interference at certain times of the year.

All in all, the non-technical passenger will be satisfied to learn that every known navigational instrument, to cope with all the known quantities likely to be encountered on this route, is included in Air France's equipment. He will be more interested to hear whether the long hours spent sitting in a very comfortable and well-furnished aeroplane are fun, or a bore. Certainly the shorter hops of the longer India route provide more distractions; it all depends on whether time or pleasure is the more important, and whether he is worried by a multiplicity of landings and take-offs. In summer much more could be seen of the fascinating and little-known polar regions, and the brave Alaskan scenery. I would always choose to repeat my own experience, by taking one route on the outward journey and returning by the other.

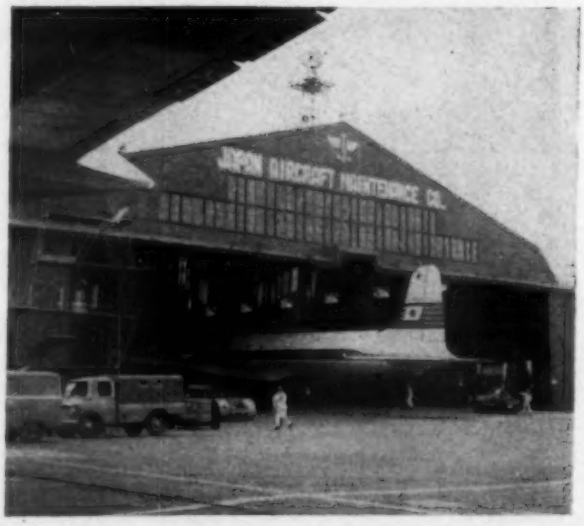
During the Anchorage - Tokyo stretch, the tedium of flying for hours above cloud and sea was inescapable, but it would have helped to sleep as much as possible, to compensate for the increasingly tricky time factor. On entering the area of the Pacific Ocean at the south-western extremity of the Aleutians, one crosses the Date Line, and it becomes tomorrow. After the unexpected dallying in Anchorage, our arrival time in Tokyo was now expected to be lunchtime (1325 on Saturday, Japanese time). At Greenwich it was then 0425 on the same day, whereas at Anchorage it was still Friday, and only 1825 at that. So our last meal on board was a meaty affair—with, of course, champagne.

Our approach to Tokyo was marred by an overcast at 2,500ft, so that we could see little of the land until we had almost arrived there. The International Airport, which is becoming increasingly busy, is soon to have a new and much longer runway parallel to the present main S.E./N.W. strip of 9,600ft. About 11,000-12,000ft is suggested for the new one, but to accommodate it the island on which it stands will have to be enlarged into Tokyo bay at several points.

Already on *terra firma* when we landed—and stealing much of our thunder—were two Tu-104s, which had brought in the Leningrad Symphony Orchestra a little while before us. Nevertheless, there was a fine welcome, formalities were brief and casual again, and Air France had certainly done us proud in every possible way.

We had enjoyed on board the *Frontenac* the skill as a *raconteur*—albeit somewhat cynical—of the French writer and journalist, Paul Mousset. This was his twenty-second visit to Japan, and everyone on board the aircraft was presented with a copy of his newest book on that country. Among his truisms about Tokyo was his comment about the native taxi-driver: if you see his arm waving about outside the window, it means only one sure thing—that the window is open.

My hotel bedroom is number 280. Adjacent to it on one side is number 278, but on the other they progress along the passage in this order: 282, 281, 285, 283, 279. To cap it all, one local Sunday paper, on the morning after we had landed in Tokyo, reported that our arrival had taken place on Sunday afternoon. I must have miscalculated somewhere.




*Journey's end on the Tokyo tarmac. In the hangar is a Japan Air Lines DC-4, bearing its country's emblem of a red rising sun.*

# FAIREY

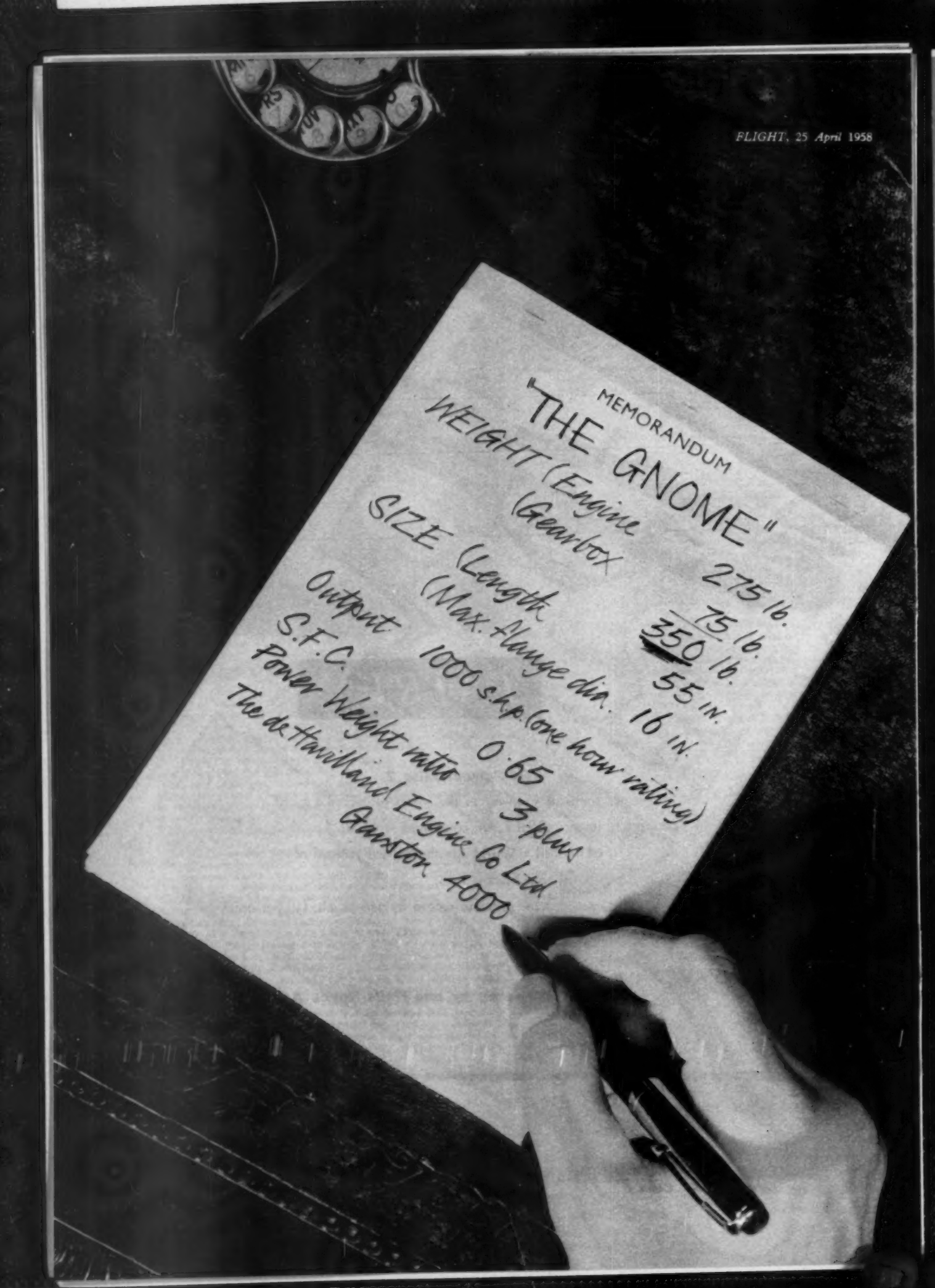
***The Fairey Delta 2***

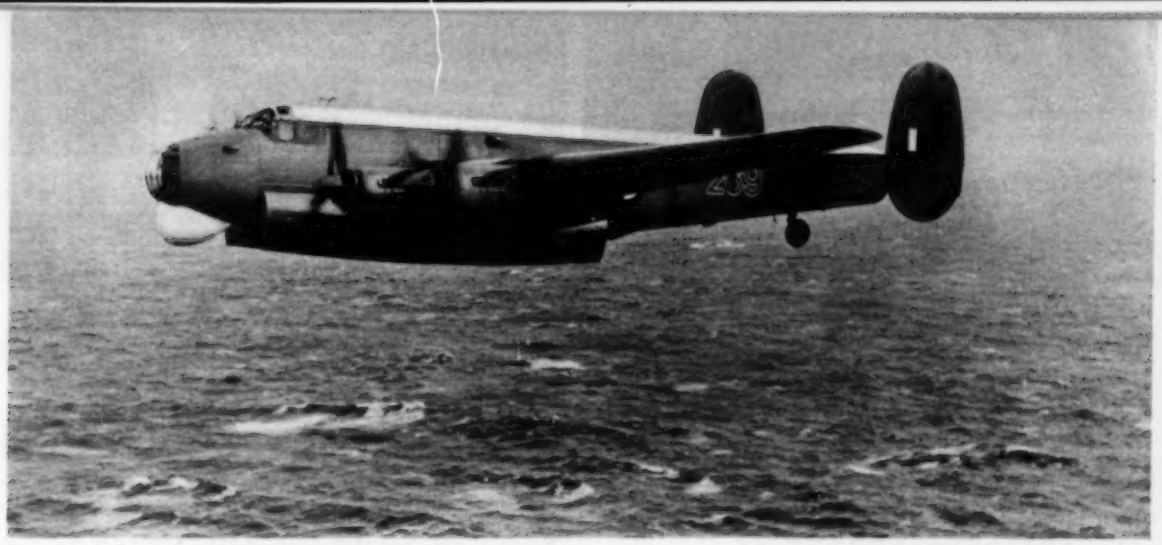
was the first aeroplane in the world to exceed a speed of 1,000 m.p.h. under official F.A.I. conditions when it established a World Absolute Speed Record of 1,132 m.p.h. on 10th March, 1956.

This exceeded the previous record by 310 m.p.h. (37 per cent).

***Powered by one Rolls-Royce Avon Jet Engine***

*THE FAIREY AVIATION COMPANY LIMITED · HAYES · MIDDLESEX*
*England · Australia · Canada*


MEMORANDUM
"THE GNOME"
WEIGHT (Engine 275 lb.
(Gearbox 75 lb.
350 lb.
SIZE (Length 55 IN.
(Max. flange dia. 16 IN.
Output 1000 s.h.p. (one hour rating)
S.F.C. 0·65
Power Weight ratio 3 plus
The de Havilland Engine Co Ltd
Anston 4000



# AIRCRAFT *versus* SUBMARINE

## *1: The Avro Shackletons of R.A.F. Coastal Command*

**THE seriousness of the possible submarine threat to this country, estimated at some 500 vessels by the Director of Naval Air Warfare in "Flight" last year, has since been the subject of a great deal of discussion, especially in relation to the submarine's future capacity to launch intermediate-range missiles. "Flight" recently visited two operational squadrons which have widely differing rôles in the sphere of anti-submarine defence, No. 269 (Shackleton) Squadron of R.A.F. Coastal Command and No. 820 (Whirlwind) Squadron of the Royal Navy. The work of the R.A.F. Shackletons is discussed in this article; Part 2 will contain a description of the Naval helicopter operations.**

NO. 269 Squadron R.A.F. is not exactly a glamour unit. In common with the other maritime squadrons of Coastal Command, its work does not hit the headlines of the national newspapers with the frequency, say, of the V-bomber force. Not only does this general distinction apply but, at the present time, 269 has the dubious honour of operating some of the oldest Shackletons in Coastal Command.

With none of the trimmings with which squadrons usually make news, then, the unit's activities are of interest simply as an example of routine maritime operations with well-proven and familiar aircraft. We visited 269 last month at its base at Ballykelly, Northern Ireland, where we were able to learn about its work and to fly in its Shackletons.

The peace-time rôle of all maritime squadrons is surprisingly varied. Continual training (as individuals, crews and squadrons) for the anti-submarine work is of course the primary effort, but, in addition, a number of ancillary tasks have been accepted as a matter of routine. These include trooping, support operations for nuclear tests, search and rescue, transport and dropping of supplies, colonial policing and escort work on ceremonial occasions.

For pilots and navigators, specified practice in pure flying and navigation is mandatory. These aspects, sometimes combined with the operational exercises described later, include asymmetric landings and overshoots by day and night; flapless landings; instrument approaches; navigation exercises and airways flying.

Operational exercises are obviously tailored to a number of variations on the theme of the Shackletons' job—to detect, track and attack submarines. Initial long-range detection is practised by means of tactical searches and patrols, and in homings by radar and other special equipment on to buoys, ships, snorting submarines and other aircraft. Accurate fixing and short-range tracking of submarines is carried out using sonobuoys; and day and night attacks with torpedoes and with depth charges complete the operational sequence.

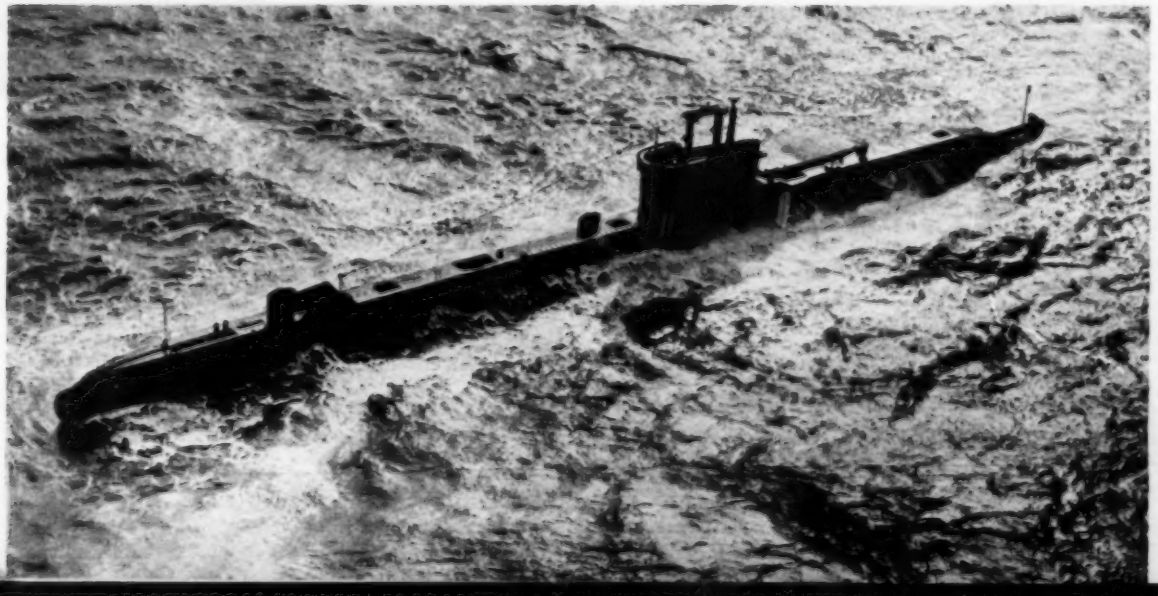
A Shackleton's normal crew consists of two pilots, two navigators, a flight engineer and five air signallers (radar, R/T, sonics equipment (two), and beam lookout position); and the working up of these groups of ten men into integrated and practised crews is obviously of primary importance. Aircraft captains can be either pilots or navigators; at the time of our visit to 269 all captains on this squadron were in fact pilots.

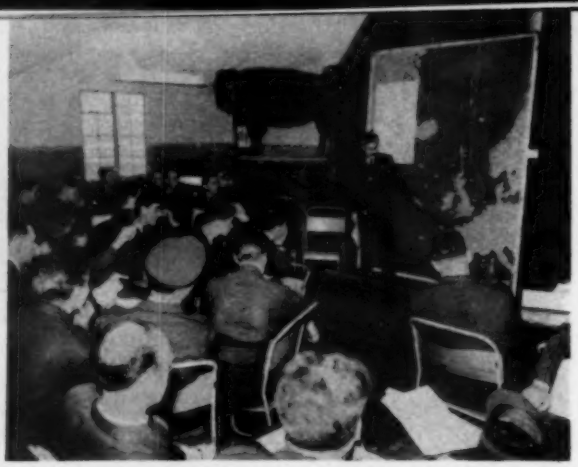
Much of the routine operation of the equipment carried by the Shackletons can be learnt on the ground, and the operational flying exercises noted above are supplemented and interspersed by periods of training in ground simulators. In one of these trainers, sonobuoy exercises are carried out by navigators and signallers. An automatic plot is kept of the tracks of the aircraft and the track of the submarine ("flown" and steered by an instructor) as the aircrew operate their equipment in separate booths representing their actual stations in the aircraft.

Realism in the flying exercises, which are frequently of 15 hours' duration, is provided by joint operation with Royal Navy sub-

*Exercises with submarines are a regular part of maritime squadron training. Above, a Shackleton MR.1 of 269 Squadron; below, H.M.S. "Springer."*

"Flight" photographs





*Left, C.O. and flight commanders of 269: W/C. A. P. Morgan, D.F.C., and S/Ls. J. R. Saunders and D. B. Robinson. Right, navigation briefing for a recent flight to Malta. Looking on is the squadron's bison mascot, reported to have flown by Shackleton from Greenwood, Nova Scotia.*

## AIRCRAFT *versus* SUBMARINE . . .

marines and surface ships from nearby Londonderry. For one three-week period each year, squadrons are attached to the Joint Anti-Submarine School at Londonderry for an intensive training course. Ballykelly is the operating base for all squadrons engaged on this course: at the time of our visit the station was host to the visiting Shackleton 2s of 224 Squadron from Gibraltar, and also a number of P2V Neptunes of the U.S. Navy. Units from the various NATO countries attend the J.A.S.S. course and standard NATO searches and exercises are practised.

Located in H.M.S. *Sea Eagle*, the Navy's Londonderry barracks, the Joint School is headed by two directors, Capt. P. F. Powlett, D.S.O., D.S.C., R.N., and G/C. G. P. Seymour-Price, D.F.C. In addition to the courses for squadrons and other units (of aircraft and ships), regular tactical courses for individual officers are organized. Apart from the instructional side of the school's work, there is also a small trials section which evaluates new operational techniques and tactics.

As the name implies, the aim of the school is to co-ordinate the work of the various branches of the NATO Services concerned with anti-submarine duties. Its courses give R.A.F. officers an insight into Naval methods and problems, and *vice versa*. Joint practical exercises involving aircraft, submarines and surface ships are held, and are discussed in useful post-mortem sessions. The use of ground simulators and tactical trainers is extensive, and in this way the operating crews of Gannets, Shackletons and ships are able to obtain experience of each other's jobs.

Apart from the annual course at Londonderry, the year-round anti-submarine training culminates in the major NATO exercises, such as last September's "Strikeback." Also included approximately once a year for the R.A.F. maritime squadrons is a three-week visit to Gibraltar or Malta. The object is intensive anti-submarine exercises, similar in scope to those of the joint school, with the emphasis on practical operations, with less classroom theory and tactical-floor games.

This, then, is the general framework of maritime operations into which 269 Squadron fits. We heard something of the squadron's history and present organization from W/C. A. P. Morgan, D.F.C., the commanding officer, shortly after our arrival at Ballykelly.

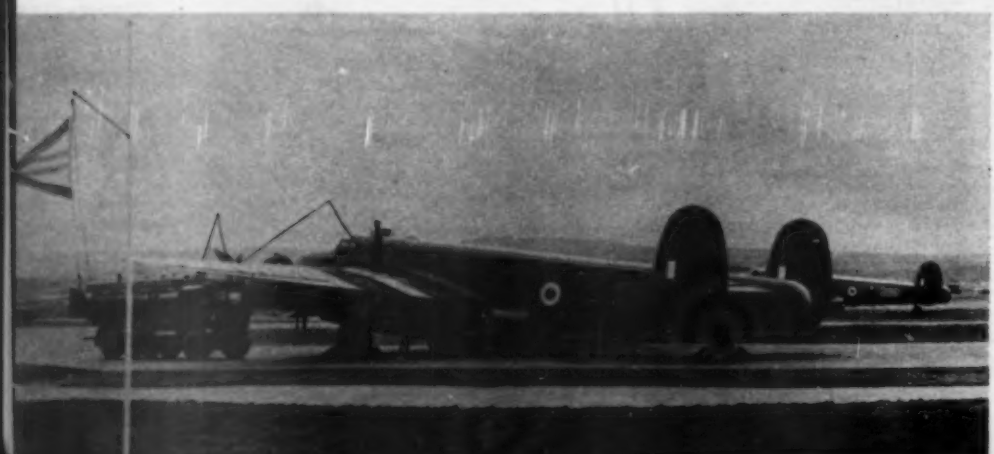
Originally established in January 1916 as the seaplane unit of the R.N.A.S. base at Port Said, this unit operated Short and Sopwith Baby seaplanes on anti-submarine patrols and general reconnaissance. No. 269 Squadron was formed in October 1918 at Port Said and flew Short seaplanes, D.H.9s and B.E.2es until disbandment at Alexandria in November 1919.

The squadron was re-formed with Ansons in December 1936 and was operating Hudsons in the early years of the second world war. Perhaps the most notable event in the whole of the squadron's history was the unique capture of the German U-boat U.570 on August 27, 1941, by a Hudson captained by Acting S/L. James H. Thompson. Damaged by the Hudson's depth charges but still seaworthy, the submarine surrendered, and its capture was completed by Naval surface ships called up by the aircraft.

At this time the squadron was based at Kaldadarnes, about 45 miles from Reykjavik, Iceland. The unique feature of the U.570 incident was the subsequent use of the ship (as H.M.S. *Graph*) by the Royal Navy in actions against German surface ships and other U-boats.

Based at Gibraltar, 269 first received Avro Shackletons in January, 1952. The squadron moved to Ballykelly two months later and has remained there, except for temporary detachments on particular exercises, since that date. As a reminder of the U.570 episode in the history of the squadron, the flag from the German ship is now prominently displayed in the entrance hall to the Officers' Mess at Ballykelly.

The squadron's present organization is based on a framework headed by the C.O. and featuring two flight commanders and four specialist officers. "A" Flight and "B" Flight are not, as might



*R.A.F. station Ballykelly, commanded by G/C. J. S. Laird, O.B.E., is host to the aircraft of various maritime squadrons. Top, a Shackleton 1 of 269 on the approach, with Binevenagh (known locally as Ben Twitch) in the background. Above, a Shackleton 2 of 224 Squadron, normally based at Gibraltar. Left, the 269 dispersal area.*

"FLIGHT" PHOTOGRAPHS

be supposed, separate groups of aircraft together making up the squadron strength; but are divisions basically between aircrew and ground personnel. All flight crews belong to "A" Flight, and the flight commander is responsible for planning the squadron's flying programme in accordance with training and operational requirements. At the time of our visit last month, this post was held by S/L. J. R. Saunders, who has since been promoted to wing commander and has taken over command of No. 38 Squadron based at Luqua, Malta. His successor on 269 is S/L. D. B. Robinson.

The responsibilities of "B" flight commander, now S/L. L. G. A. Reed, M.V.O., D.F.C., and previously S/L. Robinson, include those of ground-crew section commander, and of ensuring that aircraft are available to meet the flying programme. The specialist officers are leaders in navigation, weapons, signals and engineering respectively.

By the very nature of the Shackletons' task, the navigational standard required is extremely high. Operating for most of the time at low altitudes and at long distances from land, the aircraft are frequently out of range of radio aids. Accurate navigation is essential during routine patrols and when plotting tactical sono-buoy patterns. Among the navigation aids used are Gee, Loran, Rebecca, Consol, radio compass, radar, air position indicator and ground position indicator.

When not exercising with ships the Shackletons use two separate bombing ranges for practice dropping of depth charges and torpedoes. One of these, near the island of Inistrahull, has a stationary target, a radar buoy, on which radar homings as well as bombing can be practised. The other range is just off the island of Anglesey, North Wales, and employs moving targets towed behind launches. In addition, clear-range bombing is practised on marine markers dropped from the aircraft in open sea areas.

Our visit to 269 Squadron had given us a glimpse of the way a typical Coastal Command maritime squadron remains in training to meet the underwater threat. Other such squadrons, at a similar state of readiness, include those operating Shackleton 1s with M.A.D. (magnetic airborne detector) equipment, and those with later marks of Shackleton.

*Rolls-Royce Griffon-powered, the Shackleton 1 carries a crew of ten.*

As for the maritime crews, their duties have widened over the years to include the variety of jobs mentioned earlier, of which one topical example is transport and weather-reconnaissance flights in support of nuclear experiments at Christmas Island. In the primary anti-submarine rôle, the individual experience of trained crews adds to the effectiveness of the standard tactical procedures laid down for initial detection, tracking and killing.

The R.A.F. contribution to airborne anti-submarine warfare, therefore, is centred on the long-range, large, land-based aircraft capable of carrying full detection and strike equipment together with a large crew. The Royal Navy is at present adapting its own short-range and carrier-based experience of fixed-wing anti-submarine aircraft to the new techniques involved in the operation of helicopters; and the work of one of the anti-submarine helicopter squadrons will be described in the second and final instalment of this article. K.T.O.

# AT THE I.E.A. EXHIBITION

OF strictly aeronautical material at the Instruments, Electronics and Automation Exhibition (Olympia, London, April 16-25) there is relatively little to be seen, though much of the equipment does find application in research and development for aircraft. Many companies well known in the aircraft industry are represented by their specialized divisions in research and electronics; and the use of ionization detectors and infra-red for research purposes is noticeable, in addition to much equipment for nuclear engineering.

The R.A.E. is represented on a sizeable stand by a single Skylark sounding-rocket and a model of its launching tower, standing in completely unexplained isolation. Hard by is the S. G. Brown, Ltd., stand, displaying many of that company's products, including the Master Reference Gyro Type A5. This equipment, based on two gyros, was successfully developed several years ago and has been in production and squadron service for a long time. It is specified for all the latest British fighters and very-high-speed research aircraft. S. G. Brown are associated with American Bosch Arma and can take advantage of the principles of gyro flotation developed by the American concern. The British company has commercial rights and is progressing with the design of advanced M.R.G.s. Keen interest is being shown abroad and particularly also in the United States.

Five-channel universal trace recorders and portable ultra-sonic test gear are exhibited by Kelvin and Hughes, Ltd., while S.F.I.M. (Great Britain), Ltd., display airborne trace recorders designed by the French parent company. The research department of Short Brothers and Harland are among the many companies exhibiting computer components; and industrial, closed-circuit television systems are displayed by Pye and Marconi Instruments. E.M.I. Electronics also show this type of equipment, one camera recording the movements of a model whirling in a completely dark box and illuminated by infra-red light.

Plessey exhibit the latest version of their P.T.R. 61 V.H.F. (116-132 Mc/s) transmitter/receiver in which the spacing of the six crystal-controlled channels can be reduced to 100 kc/s. It is otherwise similar to the established design and weighs 17.6 lb. Ketay, Ltd., a company in the Plessey Group, are now manufacturing a wide range of synchros which are the first to receive M.o.S. and R.A.E. type-approval.

Gloster Aircraft's Technical Developments Division have proved adept at adapting basically aircraft equipment to the wider uses of industry. Thus their instrument panel illumination dimming system—which is shortly to be ready for service—might be adapted to the use of stage lighting, and the basic servo which has been accepted by the M.o.S. and R.A.E. for pitch damping on a fighter (and has completed satisfactory flight tests) can be used as a machine-tool servo. Glosters have worked with Brush Electrical on this system and progressed from design to production within a year. Also shown on the technical developments division's stand is a force transducer for measurement of ±60 lb force. It is for use in current aircraft and is also incorporated in the machine-tool servo system as an inductive force pick-off. Under development are displacement measurement (±0.005in) and acceleration measurement facilities from this equipment.

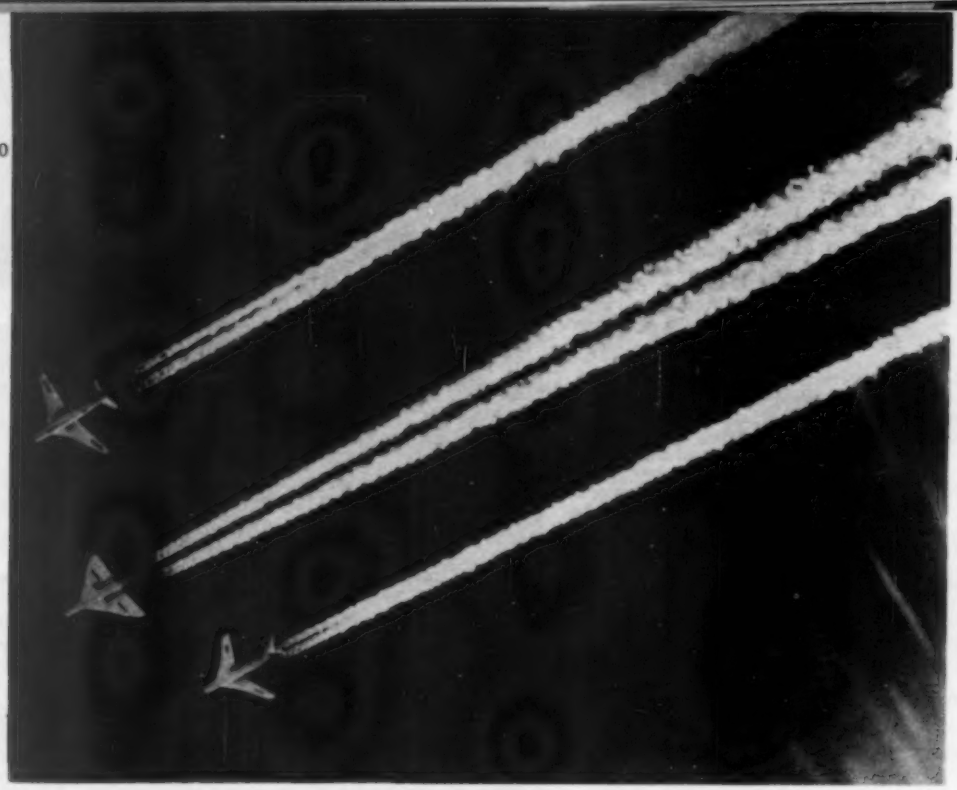
Displayed under Britannia, Comet and Hunter photographs on the R. B. Pullin stand are the electrical turn-and-slip indicators used in these aircraft. Air Trainer's Link show components for analogue computers, Fairey Aviation an electronic analogue computer and Negretti and Zambra their mostly familiar range of aircraft instruments. Exhibits on many other stands have applications in the testing and development of aircraft equipment.

## DISC BRAKES WIN A TROPHY

THE Dunlop Rubber Company are this year's recipients of the Dewar Trophy, which is presented for outstanding British technical performance in the field of automobilism. The trophy was originally presented in 1906 and may or may not be awarded each year according to the recommendation of the Royal Automobile Club's technical and engineering committee.

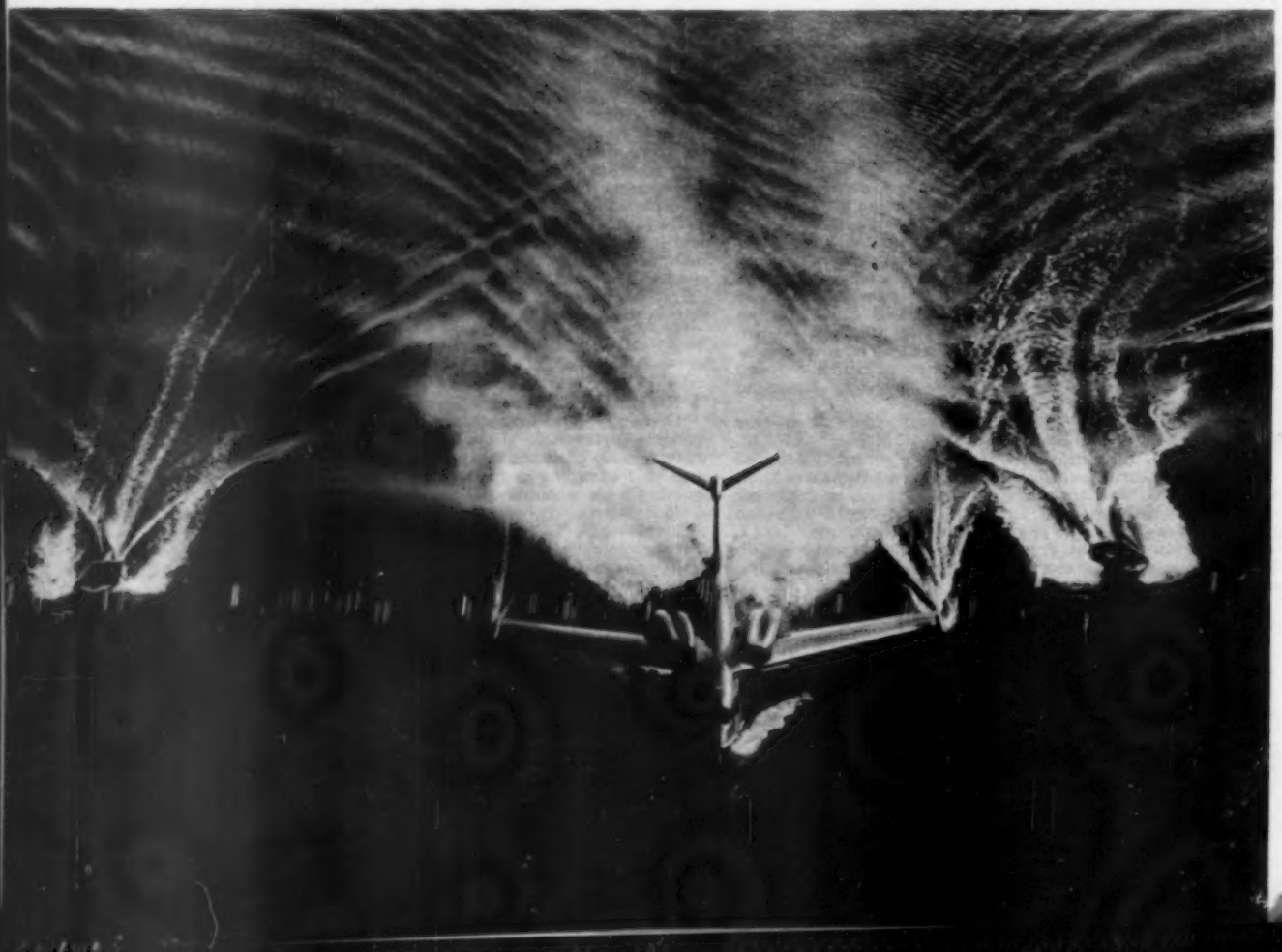
Receiving the trophy at the R.A.C. in London on Wednesday of last week, Mr. G. E. Beharrell, Dunlop chairman, made it clear that the evolution of disc brakes for cars went back to that of aircraft disc-brakes and the adoption of magnesium wheels. He mentioned in particular the Typhoon of 1944 upon which Dunlop worked and whose discs had to meet the needs of its then high performance. At that time 2¼ million foot-pounds of energy had to be absorbed; by contrast, modern aircraft called for a figure of 20 million ft lb. Aircraft disc-brakes had to work regularly at 700 deg C and in an emergency at 1,300 deg C, a cherry red heat.

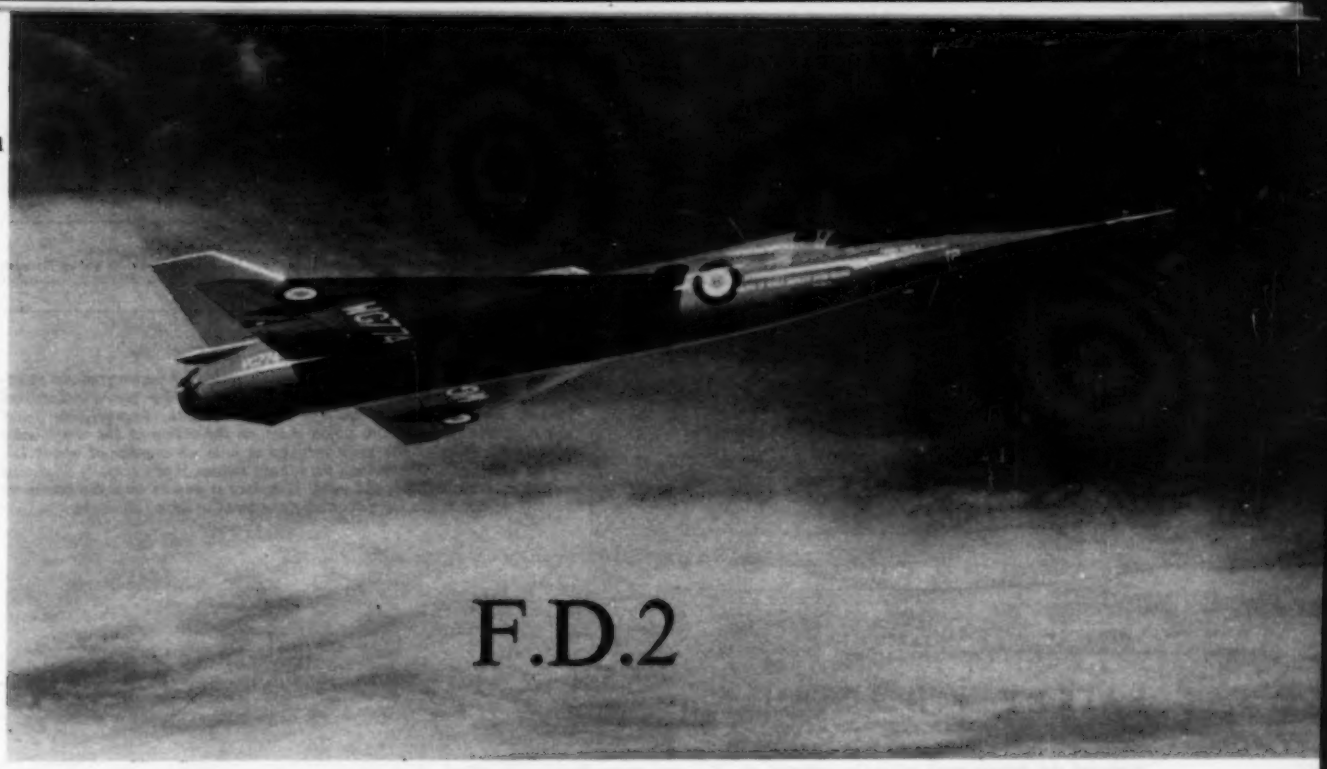
From the point of view of the automobile industry, the next stage had been initiated by Sir William Lyons, who had observed the performance of aircraft brakes and suggested that there would be a ready acceptance and great support from car manufacturers. This led to the first appearance of disc brakes on the D-type Jaguar and the Austin-Healey at the Motor Show of 1955.



# TRAILS

TRACED across sky and sea, the dynamic trails of these two trios offer a crisp contrast in design. Above, the bold and straight lines etched by V-bombers; below, the delicate interplay of the wakes of a taxying Martin SeaMaster and attendant speed-boats in Chesapeake Bay. Noteworthy details are the separate twin trails from the four Olympus engines of the leading Vulcan B.1, compared with the single merged trails from the Valiant BK.1 Avons and the Victor B.1 Sapphires; and the canted Allison J71 nacelles of the SeaMaster (the third machine of this type to be built)—intended to reduce the buffeting of the rear fuselage and tail unit when the inboard engine afterburners are used on take-off.






## *Fairey's Delta 2—Over 1,000 m.p.h. on Rolls-Royce Power*

FEW of our readers can still be unaware of the fact that the F.D.2 supersonic research aeroplane by the Fairey Aviation Company was the first man-carrying vehicle ever to prove to the world, in an officially calibrated exercise, its ability to travel at a speed greater than 1,000 m.p.h. In fact, except for American air-launched rocket machines, it was probably the first aircraft ever to reach such a speed.

Nevertheless, to appreciate the true advance in performance which this shapely aeroplane demonstrated one has to plot officially timed "world records for absolute speed" against time in graphical form (*Flight*, March 23, 1956). Until Peter Twiss, now Fairey's chief test pilot, established his remarkable F.D.2 figure of 1,132.2 m.p.h. on March 10, 1956, this record had never been broken by more than 219 km/hr (the metric system is used by the Fédération Aéronautique Internationale, who homologate such records). Twiss, however, surpassed the previous record by 499 km/hr, representing an increase of almost 38 per cent—a startling proportion.

It is worth mentioning that the 219 km/hr advance was that which occurred at the end of World War 2, when G/C. H. J. "Willie" Wilson set up the first such record by a jet aeroplane. This increase in performance over the earlier piston-engined figure was, however, much less than that which was established by the Fairey aeroplane; for the latter was the first truly supersonic (as distinct from transonic) machine to make a record attempt with sufficient tankage to fly the required pattern, and flying controls of sufficient fidelity to enable it to be flown with the necessary precision to comply with the F.A.I. regulations.

But the F.D.2 was not built just to set records. The reasons for its design, and an authoritative history of the aircraft and its test programme, are to be found in the paper entitled *The Fairey Delta 2*, read before the Royal Aeronautical Society on February 14 last year by Mr. R. L. Lickley, the Fairey Aviation Company's technical director, and Peter Twiss. This paper was published in the Society's Journal for July last and was summarized in our issues of February 22 and March 1, 1957. It is now possible to say more about the design of the aeroplane itself, and this we propose to do with the added advantage of the cutaway drawing which is found overleaf.

As an introduction it is appropriate to quote Mr. Lickley's own opening paragraphs for the paper previously mentioned.

"The development of manned supersonic aircraft in this country suffered a setback at the end of the 1939-45 war, when it was decided that the use of manned aircraft would be too dangerous; however, more realistic views soon prevailed and, as a result, the ordering of such manned aircraft was considered in 1947 by the Ministry of Supply and in our submissions to M.o.S. in 1949 we described the aircraft as having as its primary function 'Research Flying at Transonic and Supersonic speeds up to M=1.5.'

"The background which led up to this submission is of interest, as it shows a logical line of development within the Company.

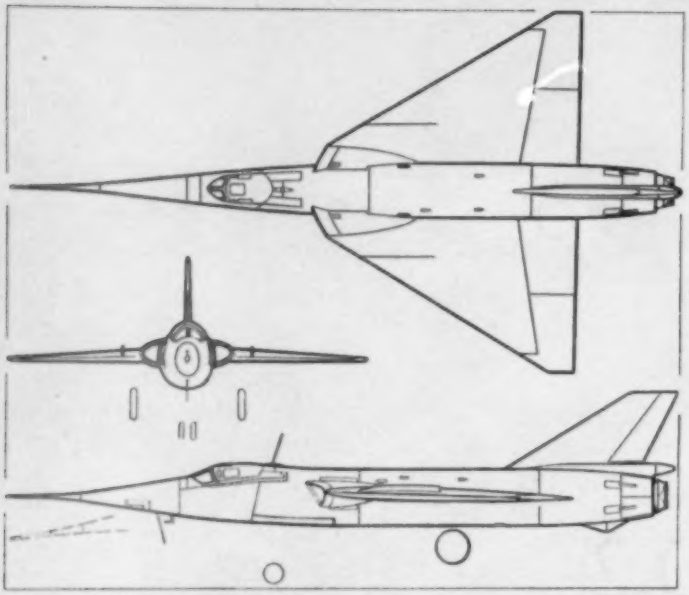
"In 1947 the Company was developing the F.D.1 at Stockport and scale models of it at Heston, in order to conduct vertical take-off experiments. The models were of advanced design, powered by a rocket motor with twin combustion chambers controlled in pitch and yaw respectively by an automatic pilot. Information of behaviour in flight was telemetered to the ground.

"In September 1947, the Company was asked if it could further develop the vertical take-off models to fly transonically after ground launching as part of the experimental programme. After consideration it became clear that, although the technique and experience of the V.T.O. models would be of great value, the experiments themselves would be of little use unless they were aimed at obtaining specific information on a layout representative of a typical possible piloted supersonic aeroplane. We therefore began a design study of such a piloted aircraft as a preliminary to the design of the pilotless models. Our first efforts resulted in a design of high sweepback on both leading and trailing edges, all-moving tip ailerons, conventional tailplane and twin engines in the fuselage fed from a nose intake (P.1-type layout).

"This design was not proceeded with, but in February 1949, we were approached by P.D.S.R.(A)—then Sir Harry Garner—and asked to consider an alternative design for a further supersonic research aircraft, preferably based on a single engine. We had, of course, by this time considerable background in the problems of designing such an aeroplane. We had developed the necessary new techniques of drag and performance estimation and had collected together what slender information there was on the stability and control characteristics of various configurations. We decided to begin our considerations afresh and, by the end of the year (December 1949) had come to a firm proposal which differed very little from the aeroplane as it is flying at present, although pressure from various sources to make changes was at times very strong.

"The design which evolved was a delta-wing plan form of aspect ratio 2, having a Rolls-Royce RA.5 engine in the body, with wing root intakes with frontal areas cut to a minimum and all possible excrescences removed. The major target and guiding principle in the whole design period was to get an aeroplane of minimum weight, with the smallest frontal and surface areas, while still remaining a straightforward aeroplane to handle in the air and on the ground, and yet at the same time, large enough to house the RA.5 engine and sufficient fuel to enable worthwhile flights to be made. As an indication of the design problems raised by this approach, the maximum clearance between engine and fuselage skin is less than 6in and, within this space, room had to be found for the main frames to which the wing is bolted.

"Although the aerodynamic form was decided at an early period, the contract to build two aircraft was not placed until October 1950; lack of money, priorities and other problems, caused this hold-up and, almost immediately after the placing of the contract, 'super-priority' intervened and the need at Fairey's to con-



**FAIREY F.D.2**
**(One Rolls-Royce Avon turbojet with afterburner)**
Span, 26ft 10in; length with typical probe, 51ft 7¼in; height, to tip of fin with main oleos under load, 11ft; track, 91.6in; gross wing area, 360 sq ft. No other data may yet be published.

*The large cutaway drawing shows all the essential features of the structure and primary systems of the F.D.2, except for security-classified items such as the tankage and instrumentation. Immediately below is a small inset diagram which gives an indication of the shock-wave pattern at one of the main intakes at a Mach number of about 1.4. The other inset, the braking parachute system, is of necessity displaced from its true position; the cable is in fact streamed from the container 33; it is also drawn slightly smaller than full scale.*

# FAIREY F.D.2 . . .

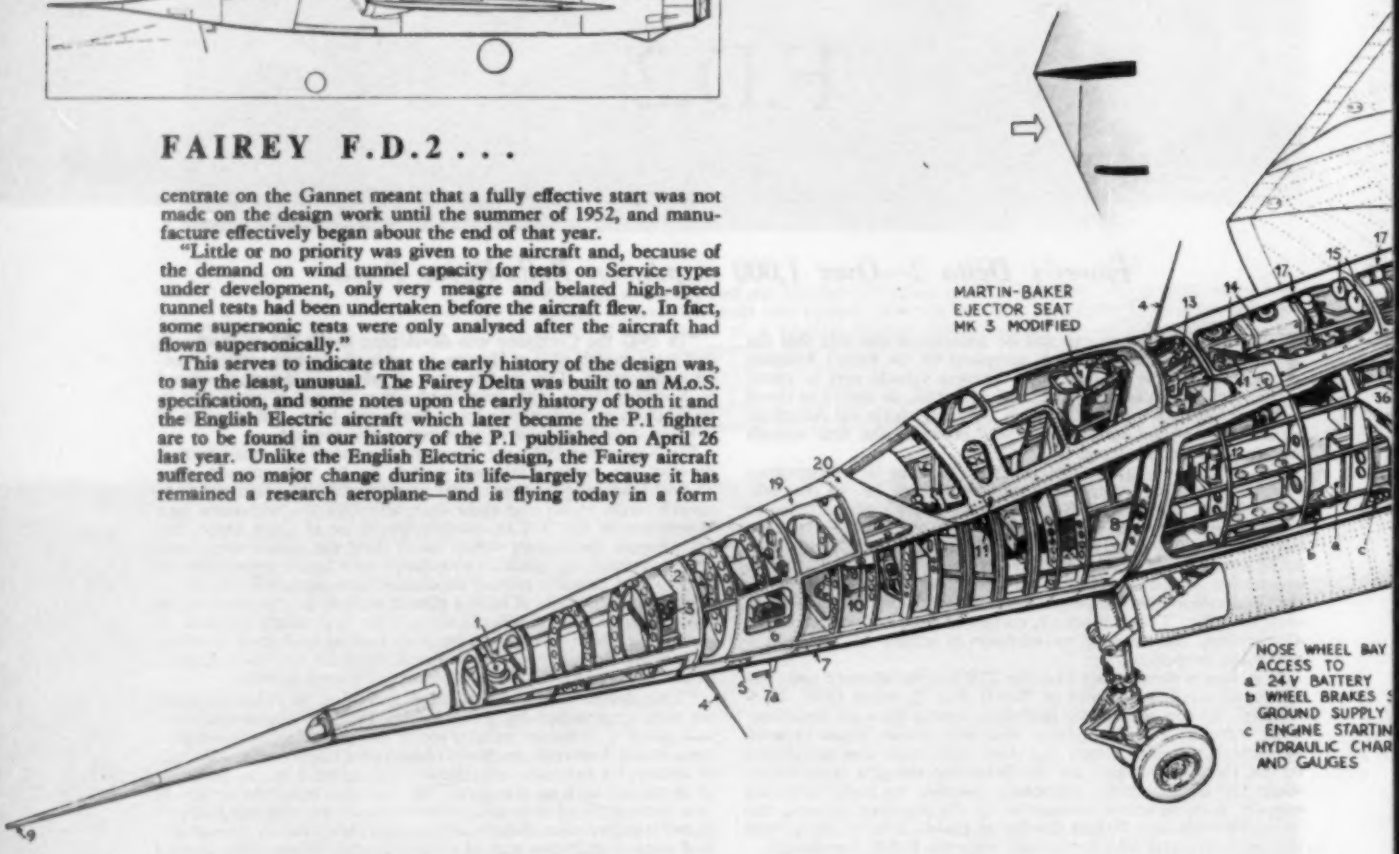
centrate on the Gannet meant that a fully effective start was not made on the design work until the summer of 1952, and manufacture effectively began about the end of that year.

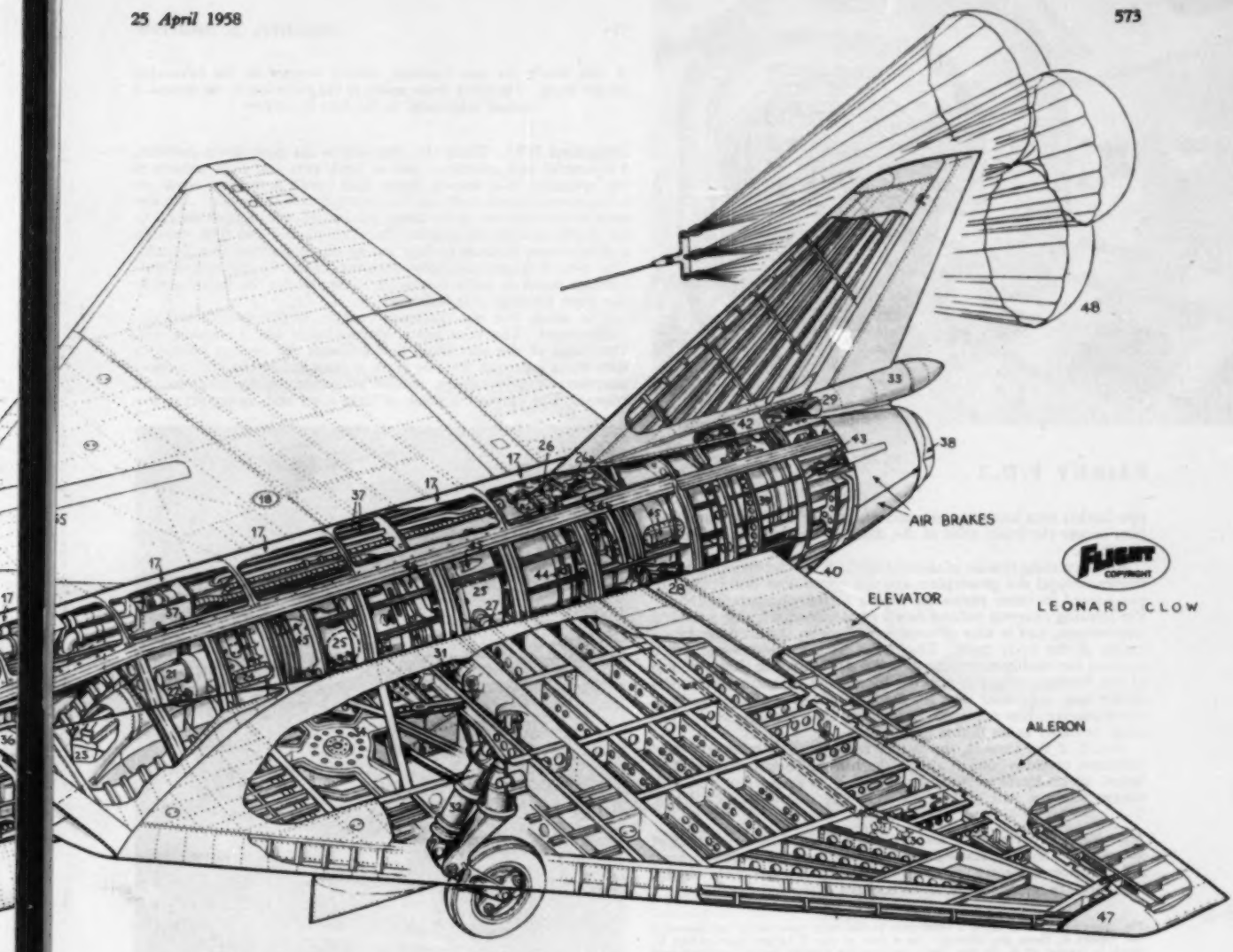
"Little or no priority was given to the aircraft and, because of the demand on wind tunnel capacity for tests on Service types under development, only very meagre and belated high-speed tunnel tests had been undertaken before the aircraft flew. In fact, some supersonic tests were only analysed after the aircraft had flown supersonically."

This serves to indicate that the early history of the design was, to say the least, unusual. The Fairey Delta was built to an M.o.S. specification, and some notes upon the early history of both it and the English Electric aircraft which later became the P.1 fighter are to be found in our history of the P.1 published on April 26 last year. Unlike the English Electric design, the Fairey aircraft suffered no major change during its life—largely because it has remained a research aeroplane—and is flying today in a form almost identical to that roughed out nine years ago, in 1949. The only changes worth commenting upon are the decisions to delete the underwing flaps which were fitted at about 50 per cent chord (the aircraft originally flew with these in place) and to arrange for the powerplant to be withdrawn to the rear, by unbolting the complete rear fuselage and fin, instead of upward through dorsal doors.

When the F.D.2 was designed, the chosen thickness/chord ratio of 4 per cent was the lowest known to have been attempted, and even today this value is still comparable with those of the world's fastest aircraft. Like nearly all supersonic deltas, the wing is structurally divided into fore and aft, rather than inner and outer, sections, and consists chiefly of essentially rectangular cells formed from members parallel to the lateral and longitudinal axes of the aircraft. The basis of the wing is a rectangular torsion box housing an integral tank. The box is built up from three principal and two subsidiary spars, all of which are arranged normal to the fuselage axis, together with five chordal members and 0.25in upper and lower skins which transmit the major part of the bending loads. Outboard of this box the construction is similar, although the spars in this area are swept back at acute angles to conform to the delta planform, all but the front and rear spars being terminated before reaching the tip.

Ahead of the main torsion box is a large triangular portion of relatively light construction. This section contains stubby pressed-sheet spanwise webs and numerous chordal stringers of channel section (the reverse of traditional construction). Much of the inboard portion is occupied by the retracted main undercarriage units, each leg being mounted on an anchorage forming an integral part of the front spar of the rectangular box and supported by an *ad hoc* bridge member spanning the wheel well. The skinning over this forward part of the wing is of relatively light gauge, and owing to the critical vertical clearance above the retracted main-wheels the skin over the wheel wells is stiffened by an unusual type of pressing, as indicated in the drawing. Although it is fabricated in two parts, the front spar follows a continuous straight line from the root of the wing to the tip. The only other member to do so is the light shroud spar at the trailing edge of the fixed part of the wing, against which the control surfaces are precisely located.






1 Compass detector unit
2 Gaseous oxygen
3 Communications radio
4 Whip aerial
5 Oxygen valve and charging point
6 Access to radio, u/c. selector, brake control valve and oxygen valve
7 Access to flying controls and air thermometer 7A
8 Cabin pressure ground socket
9 Pressure head
10 Canopy jettison (external rescue)
11 Canopy release latch
12 Brake accumulator
13 Flying-control rods and drooping-nose linkage
14 Hydraulic header tank
15 Micronic filters
16 Fuel filler
17 Access panels to equipment on top decking
18 Access to main leg hinges
19 Access to flying controls, rudder bar and trim actuators
20 Access to rudder pedal hinges
21 Electric starter
22 Accessory gearbox drive via universal-jointed shaft
23 Cabin air-conditioning equipment (see system diagram on p. 575)
24 Cabin cooling-air outlet (fed from lower boundary-layer duct)
25 Access panel to engine mounting
26 Variable-ratio gearboxes (port, aileron; starboard, elevator) governed by electric actuators 26A, and incorporating aileron load-relieving unit 26B
27 Engine rear mounting
28 Elevator power unit (port and starboard)
29 Rudder power unit
30 Aileron power unit
31 Main undercarriage jack
32 Main undercarriage shock strut
33 Braking parachute container
34 Skin stiffener over wheel bay
35 Wing fence
36 Boundary-layer bleed
37 Flying-control rods
38 Variable-area propelling nozzle
39 Afterburner retaining rails
40 Tail bumper
41 Differential lever assembly
42 Electric actuator for air-brake servo valves
43 Air-brake hydraulic jack (four)
44 Transfer-pipe joint
45 Engine-bay ventilation intakes
46 Fireproof bulkhead
47 Horn balance
48 Braking parachute assembly

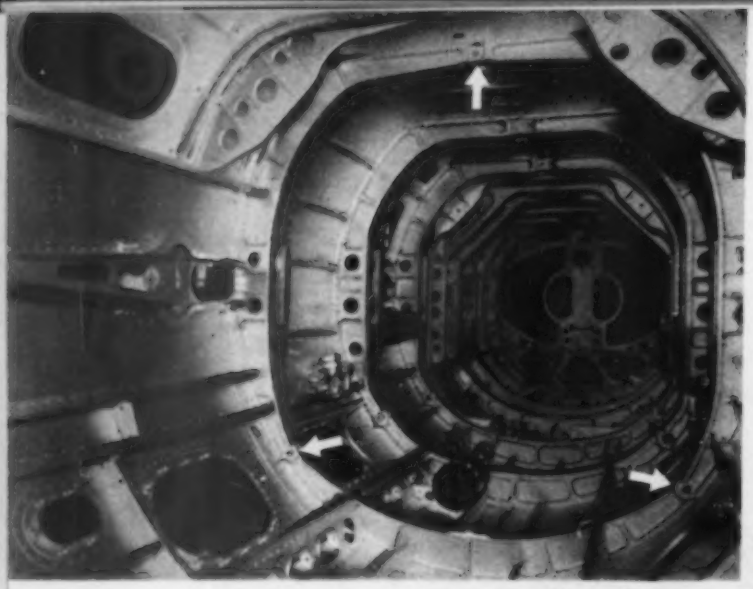
AND GAUGE
INTS (112 V)(24 V)
VALVES

Control-surface geometry is conventional for a delta aircraft, there being a rudder, inboard elevators and outboard ailerons (all with sharp trailing edges). Each surface is a simple component constructed about a torsion-box asembly with a relatively light Reduxed trailing-edge portion. All five surfaces are fully power-operated by Fairey Hydrobooster units, the pilot having a conventional control column and rudder bar assembly actuating push/pull rods leading to selector valves on the jacks. Duplication is provided by employing either twin or tandem units served by entirely separate hydraulic circuits.

Spring feel is fitted to all three axes. In combination with an electric actuator, the feel unit also serves to trim the aircraft by displacing the neutral positions of the main control circuits. The aileron and elevator systems each incorporate an electrically operated variable-ratio gearbox. Originally the two circuits were interconnected with a predetermined relationship, the change of gearing—from a direct drive up to a ratio in the region of 9 : 1—being effected from a common selector switch in the cockpit. Separate operation of the two systems has now been introduced and, with the knowledge gained from extensive flying, more advanced systems incorporating automatic selection are now envisaged.

In the design of the fuselage, frontal area assumed exceptional importance; as Mr. Lickley remarked in a paragraph previously quoted, the outer skin around the engine bay is barely 5in away from the powerplant itself. This stringent restriction on radial dimensions adversely affected the available depth for the major frames, particularly those picking up the wing spars. As a result, several of the frames are machined from solid forgings, the material being a high-strength light alloy. Frames are numbered from a datum in line with the trailing edge of the wing; the centre fuselage extends from station 27.5 to a sloping front frame with its lower edge at station 292.5 (its designation is 289.5).

Most heavily loaded of the centre-fuselage members are the forged transverse frames already mentioned, which carry the four principal spars of the wing. The three heavy machined spars of the rectangular wing box are each attached by an upper and lower ground-steel pin engaging directly with their associated frames;



*A view inside the rear fuselage, looking forward to the bifurcated intake ducts. The white arrow points to the pin-joints in the frames, a feature mentioned in the text in column 1.*

## FAIREY F.D.2 . . .

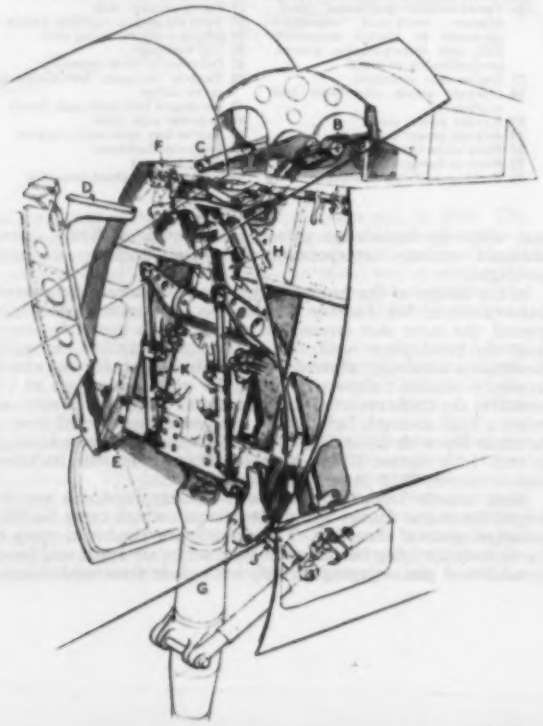
two further pins locate the inboard end of each front spar, and two pins secure the inner ends of the diagonal undercarriage bridge-members.

An interesting feature of detail design is that the majority of the frames around the powerplant are not continuous hoops but are pin-jointed in three places (as shown in the photograph above). Pin-jointing removes redundancy by making each frame statically determinate, and is also of some assistance in the accurate fabrication of the body itself. The flying-control circuits and other services are readily accessible on a flat deck running along the top of the fuselage, which is covered by a series of button-on panels which bear only their own lift loads. Indicative of the excellent serviceability thus achieved is the fact that a single F.D.2 has made as many as six flights in one day.

Ahead of the intakes, the centre fuselage is of relatively conventional construction, as also is the hinged front fuselage. The latter, which forms a pointed cone with an apex at station 482, hinges about a pair of bolts at the base of the sloping frame

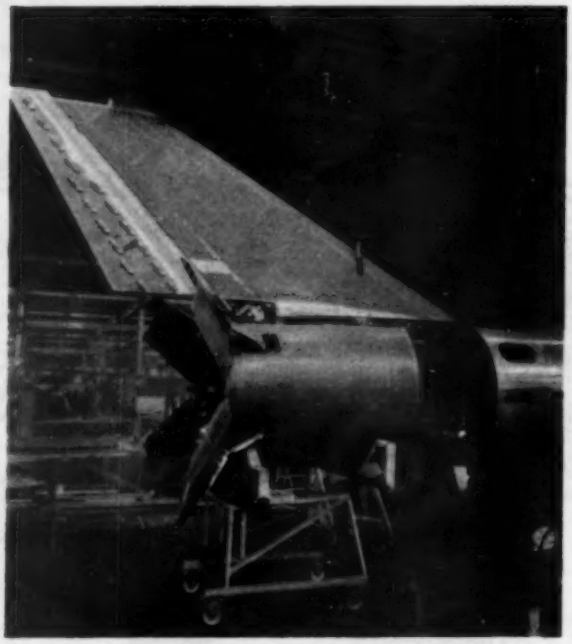
*Most highly swept or delta aircraft adopt a very nose-up attitude at low speeds. This fact, coupled with the long nose and shallow canopy, led the Fairey designers to provide the F.D.2 with a downward-hinging nose, the mechanism of which is shown in the drawing below.*

The operating jack A turns a transverse torque-tube upon which are mounted two cranks B; these are attached via a pair of ties C to the nose section D, which is hinged at E. In the "up" position the nose is locked by latch-pins at F. The nose undercarriage leg G is retracted to the rear by the jack H, which pulls up the cross member J; the doors are operated by the two jacks K, which are also energized when the nose is moved to its "down" position.




designated 289.5. When the pilot selects the nose-down position, a hydraulic jack releases a pair of latch pins and then sequences the operation of a second, larger jack which actuates a crank on a transverse torque tube on the centre-fuselage decking. On the ends of this tube are rocker arms and tie rods which push the cockpit down through an angular travel of 10 deg and then provide a dead-centre bracing linkage in the down position (see sketch). The system is interconnected with the circuit for the nose-undercarriage doors in order to provide clearance for the lower part of the front fuselage rear bulkhead.

The small, but not cramped, cockpit, is pressurized and air-conditioned. The pilot has a Martin-Baker Mk 3 ejection seat. Operation of the seat blind first jettisons the cockpit canopy, a time delay ensuring that the latter is clear before the seat is fired; alternatively, the canopy can be jettisoned by its own manual release. The canopy is made of light alloy and incorporates five



*As noted in the text below, the rear fuselage can be detached as a unit for powerplant removal. The open air-brakes can also be seen.*

Perspex panels. It can be manually hinged to starboard on a pair of fixed rails which are normally secured to the fuselage. Upon triggering of the jettison circuit, these rails are released at their forward ends and forced upwards by spring-loaded plungers. When the angular movement exceeds 15 deg the whole assembly is freed, the canopy thereafter following a trajectory which takes it well above the fin. Forward vision is provided by a low-drag windscreen consisting of a cast magnesium-alloy frame containing a pair of single-curvature glass sandwiches.

By undoing 35 bolts, the short rear fuselage can be removed as a single unit. Most of its frames are continuous hoops, and on them is mounted the fin, which has three sloping spars, together with the cylindrical container for the cluster of three G.Q. braking parachutes and the airbrake assembly. The latter comprises four petals disposed around the jet-pipe, each surface being pulled open in a forwards direction by its own hydraulic jack.

As has previously been the case with their aeroplanes, Fairey Aviation designed and built the complete undercarriage for the F.D.2. It may, perhaps, be suggested that the company felt that, in this particular case, a team of their own might be better able to evolve—or be made to evolve—an undercarriage which imposed the minimum demands upon the airframe and could be stowed within the severely restricted space available inside the optimum envelope. The nose gear comprises a relatively lengthy single strut carrying two wheels splined to a live axle. Each main gear comprises a levered-suspension unit with an oleo strut in tension and an outboard fork carrying a slim wheel fitted with a Dunlop high-pressure tyre, brake and Maxaret anti-skid unit. The limited wheel-well depth available within the 4 per cent wing dictated

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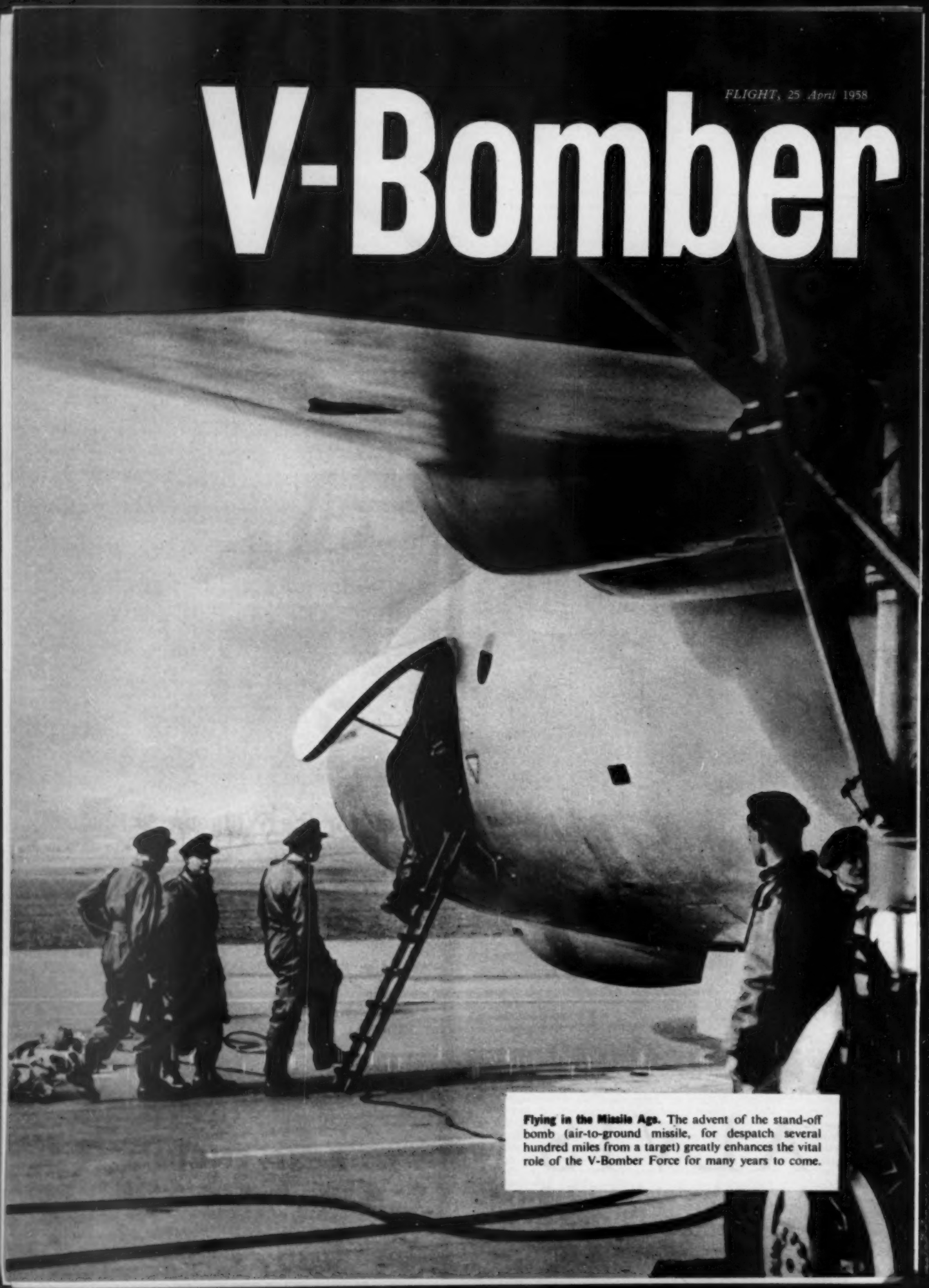
# V-Bomber



**Flying in the Missile Age.** The advent of the stand-off bomb (air-to-ground missile, for despatch several hundred miles from a target) greatly enhances the vital role of the V-Bomber Force for many years to come.

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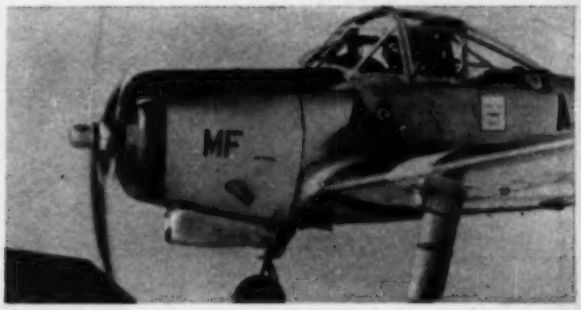


**Basic training.** Once through Hornchurch, you are a potential officer and ready to be introduced to service life and do your basic training. This you finish with the rank of Acting Pilot Officer, and your flying training begins. You learn to fly on the Provost Trainer. You make your first solo flight.

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If you are between 17½ and 26; if you have the General Certificate of Education, the Scottish Leaving Certificate, or their equivalent, then write, stating age and education to the Air Ministry, Dept. FR13, Adastral House, London, W.C.1. We will send you all you need to know.

# achievement!

**On August 28, 1957, at U.S. Naval Air Test Center, Patuxent River, Maryland, in the presence of Mr. Gates, Secretary of United States Navy, Admiral Thurston Clark, U.S.N., Commander Naval Test Center, and many U.S. Navy Officials, Flying Officer S. Hughes, R.A.F., ejected at runway level from a Grumman Cougar taking off. This ejection, the first from ground level in America, was done to demonstrate the Martin-Baker Patent Fully Automatic Ejection Seat at present being supplied for U.S. Navy aircraft. The upper photograph shows the main parachute streaming. On the right, Hughes, immediately after the ejection, is being congratulated by the designer of the seat, Mr. James Martin, C.B.E. Design features of this seat are patented in U.S.A. and Great Britain.**

**Martin-Baker**

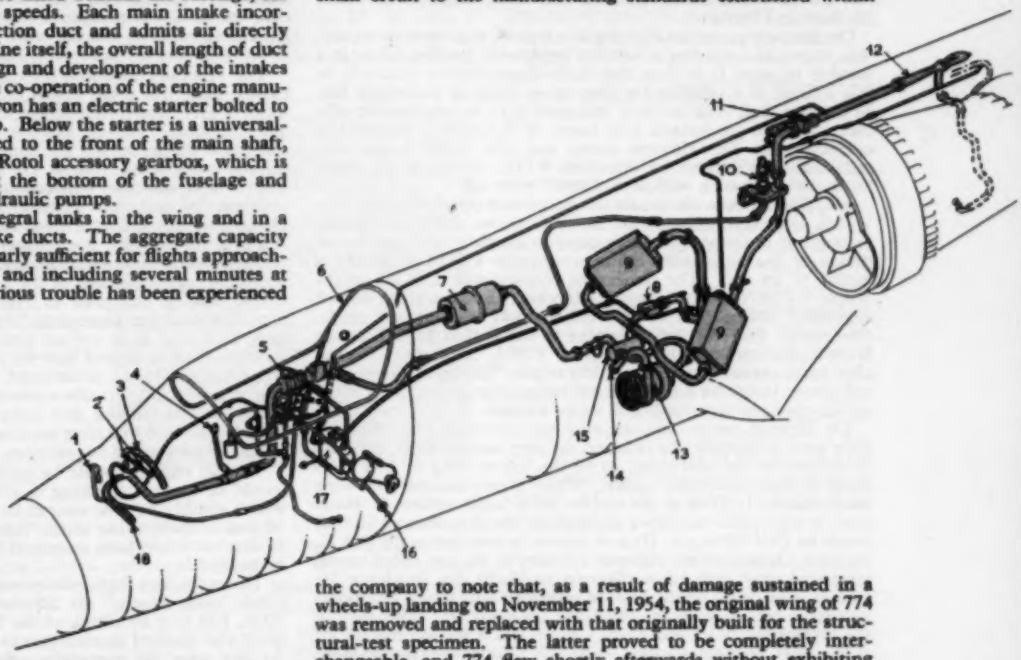
AIRCRAFT COMPANY LIMITED, ENGLAND & CANADA

## FAIREY F.D.2 . . .

main undercarriage units almost entirely of steel. Each main leg and its associated side strut is pivoted in such a manner that, during retraction, the unit is constrained to hinge about two axes while the wheel turns to lie horizontally within the wing.

Propulsion is provided by a single Rolls-Royce "second-generation" Avon turbojet—one of the earliest of the new Avons—provided with a reheat jet-pipe and a variable-area nozzle with two-position upper and lower eyelid shutters. The engine is fed with air from sharp-edged (inclined shock) lateral intakes aligned with the leading edge of the wing on each side of the aircraft. In addition, auxiliary intakes are fitted beneath the fuselage, for use at rest and at low forward speeds. Each main intake incorporates a boundary-layer extraction duct and admits air directly inwards to the intake of the engine itself, the overall length of duct being exceptionally short. Design and development of the intakes was handled by Fairey, with the co-operation of the engine manufacturer and the R.A.E. The Avon has an electric starter bolted to the upper part of the intake hub. Below the starter is a universal-jointed coupling, likewise geared to the front of the main shaft, which transmits the drive to a Rotol accessory gearbox, which is located ahead of the engine at the bottom of the fuselage and drives a D.C. generator and hydraulic pumps.

Fuel is contained within integral tanks in the wing and in a collector cell between the intake ducts. The aggregate capacity may not be revealed, but it is clearly sufficient for flights approaching a duration of half an hour and including several minutes at maximum reheat thrust. No serious trouble has been experienced




*Disposition of main units of the air-conditioning system: 1, canopy seal exhaust; 2, windscreen sandwich ducts; 3, demisting vents; 4, punkah louvre; 5, thermostat; 6, canopy seal; 7, water extractor; 8, pressure-ratio controller; 9, pre-coolers; 10, temperature controller; 11, gate valve; 12, venturi; 13, cold-air unit; 14, compressor exhaust; 15, flow augmenter; 16, static vent; 17, pressure controller; 18, foot distributor vents.*

with the integral tankage, which was sealed by slushing with a rubber compound. Air pressure (compressor bleed) transfers the major part of the wing fuel to the bag-type collector tank, and electric booster pumps feed from two cells—one in each wing—which are employed as reserve tanks. The complete system is cross-coupled to minimize travel of the aircraft c.g. about both horizontal axes, the proportioning unit which accomplishes this being a product of the Gloster Aircraft technical development division. Fuel from the collector bag is fed jointly by an S.P.E. turbine pump driven by air from the Avon's compressor, and by an electrically-driven pump, both units being mounted at the bottom of the cell, immediately ahead of the accessory gearbox. A recuperator is provided for sustained negative-g flying, and reheat is automatically cut out of circuit when the fuel level in the collector bag falls to a predetermined low value.

Major electrical loads are served by a D.C. 28-V system energized by a single generator, which charges a battery located in the equipment bay between the intake ducts. Three-phase power for flight instruments and other equipment is generated by a Type 100A inverter. Hydraulic services are provided for the powered controls and for the operation of the undercarriage, airbrakes, wheel brakes and nose hinging. Since the flying controls are fully duplicated, there are two independent hydraulic systems each energized to 3,000 lb/sq in by its own Lockheed pump. Following in-flight flame-out, emergency operation of the flying controls and undercarriage extension can be accomplished by a drop-out Rotol ram-air turbine pump mounted beneath the rear fuselage.

Principal contractor for the air-conditioning was Sir George Godfrey and Partners, and this system is depicted in a separate diagram. Compressor bleed air is passed through a pair of pre-coolers (the latter being cooled by ram-air) and thence via a Godfrey brake-turbine cold air unit before being ducted through a water extractor and into the cockpit. Air at the full pressure of the Avon compressor delivery is tapped from the line to the fuel turbopump and passed to sandwich ducts for demisting the windscreen. Gaseous oxygen for the pilot is fed from a bottle ahead of the forward pressure bulkhead.

Fairey Aviation manufactured two F.D.2s, bearing the serial numbers WG 774 and 777; in addition a third airframe was built for structural-test purposes and was eventually loaded to destruction. The bulk of the manufacturing and testing of the aircraft was handled by the experimental department at Hayes, although a number of minor parts were subcontracted. Fairey's own system of envelope jigging was employed in such regions as the leading edges of the wings, the nose and cockpit, and in certain other areas requiring extreme precision and a close-tolerance exterior profile.

It would be invidious to attempt to outline the flight-test programme of the F.D.2, in view of the R.Ae.S. paper by Peter Twiss; but a few highlights are well worth comment. Twiss took 774 into the air for the first time on October 6, 1954, and the opening sentence in his first report was, "The aircraft shows every promise of being a very pleasant flying machine." It is a matter of no small credit to the manufacturing standards established within the company to note that, as a result of damage sustained in a wheels-up landing on November 11, 1954, the original wing of 774 was removed and replaced with that originally built for the structural-test specimen. The latter proved to be completely interchangeable, and 774 flew shortly afterwards without exhibiting any change in its characteristics.

It was on February 15, 1956, that WG 777 first flew, and this aircraft, differing slightly in equipment and basic instrumentation from its predecessor, has since been engaged in numerous M.o.S. research programmes, operating chiefly from the R.A.E., Bedford. Late in 1955, however, Fairey had begun to think seriously of making an official attempt on the world speed record; and, as the performance boundary of the aircraft was pushed further to its limit, it was gradually appreciated that the F.D.2 was a thousand-mile-an-hour aeroplane. The story of how the record was achieved was outlined in our issue of March 23, 1956. The course over which the aircraft was flown measured 9.67 statute miles between Chichester and Ford in Sussex. The height separation achieved at the "approach gates" on each run was no more than 98ft, an extraordinary testimony to the flying qualities of the aircraft and to the skill of its pilot. The measured speeds on the two runs were 1,117.6 m.p.h. and 1,146.9 m.p.h., the mean being 1,132.2 m.p.h. or 1,822 km/hr—about Mach 1.73. The runs were made at a height of approximately 38,000ft.

In the autumn of 1956, Fairey's programme with the aircraft was becoming so severely restricted by the conditions obtaining in the British Isles that it was decided to seek a more sparsely populated environment. In co-operation with the French C.E.V. at Bretigny, WG 774 was based at Cazaux, near Bordeaux, between October 11 and November 15, 1956. Trials from Cazaux started on October 15, and during the succeeding month 52 sorties were flown. Approximately six hours were logged at Mach numbers greater than 0.96, and fully supersonic flight was achieved down to 3,500ft.

It is understandable that no details may be given of the recent work upon which the two F.D.2s have been engaged, although it is known that one of them is associated with experiments upon supersonic ejector-type propelling nozzles of various designs intended to increase performance. Pilots who have flown the aircraft include Fairey's own Gordon Slade and J. O. Matthews in addition to Peter Twiss, as well as numerous pilots from the R.A.E. and elsewhere. Several hundred research flights have been made by the two aircraft, and their value to a nation almost devoid of supersonic aeroplanes has been incalculable.

# The Griffith Airliner Explained

## COMMENTS ON DR. C. T. HEWSON'S R.Ae.S. LECTURE

PART 1

BY JAMES HAY STEVENS, A.F.R.Ae.S.

ON April 15, Dr. C. T. Hewson of Rolls-Royce explained much of the basic background-thinking of the now familiar supersonic VTOL dart scheme of Dr. A. A. Griffith in a Royal Aeronautical Society Section lecture. In the chair was Mr. David Keith-Lucas, director and chief engineer of Short Brothers and Harland.

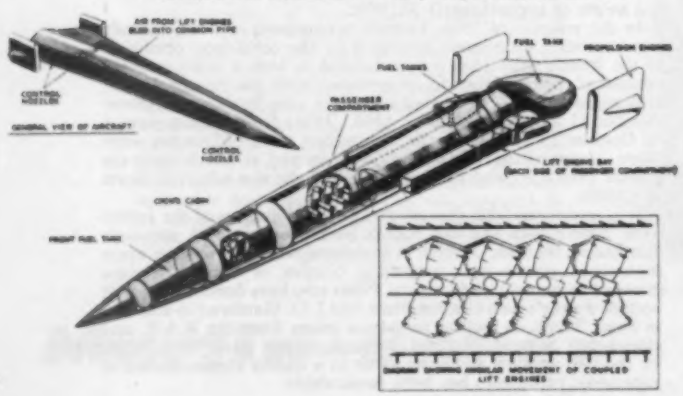
Dr. Hewson presented his case in a logical, step-by-step exposition, repeating a number of familiar arguments, but also filling in a number of gaps. It is clear that Rolls-Royce believe sincerely in this scheme as a solution for long-range flight at something like M 2.5 and that, even in these stringent days, a considerable officially-financed programme is in hand. It is, however, essential to appreciate—as Dr. Hewson stated and Mr. Keith-Lucas emphasized—that despite the imminent VTOL testing of the Short SC-1 the supersonic vehicle is twenty years off.

Mr. Keith-Lucas also made the point, and drove it home, that VTOL as an accomplished fact is with us *now*, and that it would be tragic if in Great Britain we came to couple it with the far-off dream of the supersonic airliner—wherein VTOL is simply a means to an end. The danger he foresaw was that we might couple VTOL with the enormous development costs of the distant supersonic project and thereby fail to apply it to present needs. One recalls that in a recent lecture to the Belfast Branch of the R.Ae.S., the speaker when surveying VTOL commented favourably upon ducted-fan lift for a 300 m.p.h. "Heron replacement," tail-sitting jet lift for a zero-take-off interceptor, and a "flat-rising" jet-lift configuration for Naval strike aircraft.

Dr. Hewson opened his case with the statement that (although tests were incomplete) he believed the very narrow delta, elliptical in section on the centreline, to be the lowest drag or best L/D shape at high supersonic speeds. Where a conventional thin wing might have a L/D of 6, the narrow delta could achieve 8. However, at reasonable incidence the stalling speed of such an aircraft would be 250/350 m.p.h. [It is of interest to note that at the R.A.E., Bedford, Open Day last summer a display in the low-speed tunnel suggested very high lift-coefficients at 15/20 deg incidence for such narrow deltas on the basis of separated flow which engenders two large conical vortices which roll up along and from each of the sharply-swept leading edges.] From this it follows that jet lift is the only possible solution—and the resultant thrust must be equally disposed about the c.g. The next stage is that, in order to reduce interference with the airflow over the aircraft, the propulsion engines must be at the wing-tips, which on a dart means almost the tail and virtually precludes their deflection through 90 deg as a lift component.

The resulting aircraft, epitomized as a transatlantic project, is that publicized by the Air League of the British Empire as a M = 2.6 (1,500 kt, 1,730 m.p.h.—or the Atlantic in two hours) aeroplane cruising at 50,000-60,000ft. The passengers would be carried in a windowless, pressurized cylinder "since there is little point in looking out at 50,000 to 60,000ft"—a view with which the writer completely disagrees. The crew has its own cylinder, the lift engines are grouped in pairs alongside the cabin and from them air is bled and ducted in a trunk to the three control nozzles, i.e., nose, port and starboard. Fuel is carried fore and aft, the tank flow being regulated to maintain a substantially static c.g. Jet-lift thrust is estimated by Rolls-Royce at 10-15 per cent above the gross weight. It is interesting to note that Ing. Zborowski, the Coléoptère protagonist, and other authorities have given 25 per cent excess as the minimum to provide adequate acceleration in the crosswind case. On the other hand, the U.S. factor, according to Dr. Hewson, is considerably less than 12.5 per cent.

*Conception of a possible VTO long-range transport aircraft.*



The vertically mounted lift-engines (RB.108s, quantity undisclosed, since this could reveal their thrust, but probably a minimum of fifty) would have intake shutters in the upper wing surface and (Nimonic?) exhaust shutters in the lower surface. Dr. Hewson made the point that the control jets, even though the bleed-air allowance is appreciable, are additive to the lift thrust, being shared in equilibrium between the three nozzles and maintained constant by balanced increase/decrease of control-nozzle area changes so that the total bleed remains constant.

These lift engines, the speaker admitted, must be started unfailingly and almost simultaneously because of the high fuel consumption (say a thirtieth of the gross weight every minute), both before take-off and prior to landing. In discussion, the speaker admitted that the momentum drag of the lift-jet air would be very high and is as yet an unsolved factor in the acceleration problem, but he denied that the jet efflux would be a problem in this respect. On the other hand, questioners established the fact that ground (suction) effect would be sufficiently high to require a take-off and landing grid some twenty feet above the ground. Dr. Hewson said that after hearing the SC-1 fly he felt the RB.108s would require noise suppressors.

The lift engines would be mounted in pairs on trunnions and would be capable of tilting to give an accelerating component—which would carry the aircraft beyond its stalling speed—at take-off and a decelerating thrust before landing. At a tilting rate of 10 deg/sec it had been estimated that the gyroscopic couple would be negligible.

The exemplary flight plan presented suggested an initial vertical climb "quite slowly," say 20ft/sec (1,200ft/min or 14 m.p.h.), to 100ft, followed by tilting of the lift engines to 20 deg and a forward-and-upward acceleration to 500ft in a total time of 30 sec. At this stage the propulsion engines would be lighted and the aircraft accelerated through the 300 m.p.h. stalling speed, the lift engines being cut at about 350 m.p.h. after one minute's total running time and the aircraft climbing away and accelerating to M = 2.5 at 50,000ft. The descent phase was shown diagrammatically, starting at 350 m.p.h., 1,000ft and 5 miles from touchdown. Lift engines would then be started, propulsion engines cut and the lift ones swivelled to give decelerating reverse thrust down to 100ft, from which point vertical thrust would bring the aircraft down at a mean rate of 20ft/sec—total lift engine running time two minutes.

Dr. Hewson thought that by the 1970s air passengers could be conditioned to accepting decelerations of $-0.5$ g, thus reducing the lift-jet running time to one minute—and saving about 3 per cent of the gross weight. He admitted that, even though Rolls-Royce is developing automatic devices which will give precisely controlled rates of descent and the pilot will have an override, the approach phase would be "a pretty smart operation." Personally, one would liken it to driving into one's garage at 30 m.p.h. and putting on the brakes at the threshold to stop precisely at the end wall. Even more involved is the approach phase; although this at first appears preferable to a 5 deg approach at 130 m.p.h., it must be realized that only the last 100ft would be vertical—the other 900ft (and five miles) would be a decelerating ellipse! A steady rate of vertical descent, which Rolls-Royce appears to have in mind, would entail not only a variable horizontal deceleration, but a variable g effect upon the "bodies" in their windowless container.

Dr. Hewson said that the vital necessity of ensuring a supply of the fuel and the igniting spark to the lift engines for relighting before the descent would be assured by a ram-air turbine, so that these units are independent of the main engines. The actual motoring of the lift jets is still the subject of investigation. Since there is suction, not ram pressure above the wing, some form of retractable intake scoop would have to be extended. Probably a small opening would be used to entrain the airflow at high speed so that a static head could be recovered from the kinetic energy. A positive intake efficiency of only 15-20 per cent would give quite a good pressure drop through the compressors at the dynamic head of, say, 500 m.p.h.

*(To be concluded)*

# Straight and Level

PRESSING for higher fares, the U.S. domestic airlines point out that air fares today are no higher than they were in 1938. The flaw in this argument is that it ignores improvements in technology. That an electric light-bulb cost £1 in 1890 is no argument for pricing it at £1 today.

Likewise, the U.K. trade unions will fight redundancy in B.O.A.C. by pointing out their big increases in productivity over the years. Certainly productivity has increased, but employment cannot be related *pro rata* to production in an industry which is developing so rapidly, thanks to advances in technology. As I remarked a few weeks ago, if B.O.A.C. were to man their 707s according to the productivity-standards of H.P.42 crews, they would need about 70 pilots in control of each aircraft.

But frivolity apart, the business of relating labour to production is one of the grave social problems of our time. It is all summed up in the word automation. Personally, I feel very sorry indeed for the skilled and loyal B.O.A.C. people whose jobs are to fall before the cruel sickle of advancing technology.

● Ten out of ten to Harold Caplan for writing recently in *Flight*:—

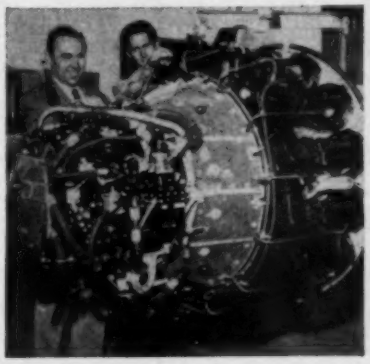
> "National sovereignty is an invaluable principle for dividing the surface of the Earth into economic or defence units. It becomes a dangerous disease of the mind when used to stifle individual liberty of thought, or when it is used to project nationality from the surface of the Earth up into space itself."

The international air lawyers have been Sputniked. Who cares any more about the sovereignty of territorial airspace? Sovereignty extends as far as it can be enforced, and no further. If we are going to be bombed, we shall be bombed by ballistic missiles fired from the ground.

● Maj-Gen. Howze, the Director of U.S. Army Aviation, has a poor opinion of those little one-man "personal helicopters," or vertical-lift devices, to accord them their proper name. He is on record as saying "you immediately think of whole divisions or regiments crossing rivers with these things, but second thought suggests that most of the troops would wind up in the river." Up the creek with two paddles, in fact.

Talking about army vertical-lift devices, the U.S. Army have a wonderful term for their projected VTOL for battlefield operations. It is ZPGV, standing for "zero-pressure ground vehicle."

● This naturally leads us on to the other end of the scale. Guess what is the "maximum pressure ground vehicle" (excluding a railway locomotive or travelling crane)? It is a female of the human species, wearing spike-heeled shoes. Remember, ladies, when next you board an airliner, that fear of your heels has probably put several hundred pounds dead-weight into the structure of the floor, in order to accept a point load of some 200 lb/sq in. In fact, if you happen to weigh 200 lb, and are ill-advised enough to buy shoes with heels of ¼ sq in . . .



● Military aircraft cannot be sold to civilians, according to U.S. Government regulations. So what does Bob Kamensky (above, left) do? Why, he travels around between Alaska and the Sahara for about three years, buying and collecting spare parts, and then he builds himself a T-33 Shooting Star. How many separate parts? About 15,000. I wonder when the Popular Flying Association will get around to approving the T-33 for amateur construction in Britain? The picture, by the way, shows the J33 engine which Kamensky also made himself.

● Last week I propounded a simple teaser involving a training mission with a B-52. I suggested that a 400,000 lb aeroplane flying from west to east lost some 3,500 lb weight and gained a like amount when flying westwards. This is the difference accounted for by the variation in centrifugal (or centripetal) force as the aircraft flies around the earth. The aircraft starts off with a rotational and peripheral velocity due to the rotation of the earth and superimposes on this its own true ground speed. The variation between the two speeds (equal to twice the true ground speed resolved along a parallel of latitude) results in the difference in apparent weight. Anybody disagree?

● Again and again I hear the plea for better cockpit visibility. Personally, I do not see how bigger windscreens are going to help solve the growing collision problem. Pilots have too much to do, and in any case they find it optically impossible to keep the sky under constant surveillance for hours at a time. Even if they could do so, there is not much time for action at today's closing speeds.

The see-and-be-seen principle is as dead as the many conscientious aviators it has already killed. Responsibility for the safety of air navigation is upon the ground controllers and the designers of navigational and safety equipment. I suggest that, except for the take-off and landing, windscreens might just as well be plated over for all the use they are.

● Here's the old, old argument again: Courtland S. Gross, who is now president of Lockheed Aircraft, is quoted as saying that "primary air weapon-system responsibilities" should be awarded to companies that have "historically demonstrated capacities in the aircraft business." You know, I'm certain that in 1458 the president of the True-Yew Bow Corporation said that "primary responsibility for army systems, including artillery, should be given to firms who have demonstrated their ability to make the best bows and arrows." I am not saying that Gross is wrong; merely that one cannot be dogmatic about such things. After all, Lockheed started from scratch once.

● From my friend Favonius in Santa Monica comes this thought for the day —extracted, he claims, from the Douglas company's philosophy in the design of the DC-8:—

> *"We have not succeeded in answering all of your problems. . . . Indeed, we feel we have not completely answered any of them. The answers we have found only serve to raise a whole set of new questions. In some ways we feel we are as confused as ever, but we believe we are confused on a higher plane and about more important things."*

● What is a sandwich? I see that the transatlantic airlines are bickering, as I thought they would, over the definition of this homely comestible. Some airlines are apparently offering their economy-class passengers a slice of bread mountainously piled with bacon, eggs, mushrooms, and even peaches and cream.

Why don't the airlines who are sticking to the rules (they include B.O.A.C. and PanAm) admit that you cannot define a sandwich without making I.A.T.A. look childish? The thing which matters to the economy of lower-class service is the weight and extent of catering equipment, and the number of cabin crew on board. This is what should be defined, not a silly old sandwich.

● Let *me* tell I.A.T.A. what a sandwich is. It's the man in the middle of a triple-seat airliner chair.

ROGER BACON

# CORRESPONDENCE

*The Editor of "Flight" is not necessarily in agreement with the views expressed by correspondents in these columns. The names and addresses of the writers, not for publication in detail, must in all cases accompany letters.*

## That Sense of Urgency

YOUR correspondent Mr. Alan Moorcroft (April 11) says that "passenger appeal" is the key to the turboprop v. turbojet question. Indeed it is, but not in the narrow sense chosen by Mr. Moorcroft as the basis for his assumption that the jet is the logical universal vehicle for short-range air services.

Passenger appeal might also be taken to include cost and frequency of service as well as speed and (relative) comfort.

What evidence is there that the higher load-factors resulting from "jet appeal" will balance the higher operating cost of the jet? And assuming, as Mr. Moorcroft does, that the majority of operators will use jets for a majority of their short-range services, which will be the lucky one retaining the higher load-factors?

There are only two ways in which an operator can achieve load-factors above the 60-65 per cent level: (a) by securing an equipment advantage over his competitor; (b) by restricting the supply of seats.

Large-scale operation of short-range jets would mean that any high load-factors resulting from method (a) would be both temporary and insignificant, while method (b) is not consistent with the nature of air transport, which is a competitive, expanding industry.

The "higher load-factor" argument makes sense only when one is advocating *limited* use of short-range jets. The temporary, artificial raising of load-factors in this way is the pulley which enables the jet to hoist itself by its own bootlaces. What happens when the pulley is taken away?

If Mr. Moorcroft seriously wants the industry to devote itself to the production of large quantities of short-range jets within such a tight schedule (and I wonder, incidentally, whether he has a clear idea of the effort and investment involved), he will have to produce a much more substantial case for the jet.

Surely the last thing the British aircraft industry can afford is yet another civil aeroplane which nobody buys but which "seemed a good idea at the time." I would suggest that the B.E.A.-sponsored jet is already a likely contender for this category without increasing the odds against it by bringing it forward from 1964 to 1961.

Since I have expressed the above opinions as a taxpayer, and not as the spokesman of the aircraft company which employs me, I ask leave to sign myself

Thames Ditton, Surrey. TURBOPROPAGANDIST.

## Jargonisation

THE letter from L. B. Greensted (March 28) concerning the growth of this cult of meaningless jargon is refreshing. Perhaps the use of this hideous language makes a writer feel that he has a superior technical knowledge. As long as we lesser folk fail to understand him, no doubt he has!

A writer recently said that the junior countries would be "missilized" in a few years. This remarkable event should complete the "sonalisation" of European defence. Interesting—isn't it?

Cookham, Berks. J. C. STRETTON.

## "Private Pilot's Dilemma"

I READ Mr. Dible's article "Private Pilot's Dilemma" (*Flight*, April 11) with some interest, as it demonstrated rather well what can happen to a private pilot when things don't go right.

The flight proposed was reasonable if weather conditions had remained good, but several points emerge from what actually happened.

It is easy to be wise after the event, but is it advisable to base a flight of this nature on an "actual" weather report, when a route forecast (which is available from the Met. Office on request) would almost certainly give warning of the threatened bad weather.

Secondly, by becoming I.M.C. whilst still over the Channel the pilot cut out all further chance of map reading, and had to resort to trying to tune-in the Chatham Range. This was apparently unsuccessful, but what about the Radio Range at Dunsfold? Wouldn't this have served him just as well?

Mr. Dible then goes on to deplore the fact that the R.A.F. Fixer Service on 121.5 Mc/s is not mentioned in the U.K. *Air Pilot*. If he will turn to "Communications 5" and "Search and Rescue 3," he will find adequate information on this service.

The pilot should also check on the S.E. Free Lane procedures into Croydon. The Free Lane runs from Godstone to Croydon, via Kenley aerodrome, not from East Grinstead as stated by your contributor.

Mr. Dible seems rather surprised at the fact that he was made to climb from 1,200ft to 1,500ft when reporting that he was I.M.C. in the Free Lane. If he is familiar with the Free Lane, as he states, he should know that flight within it should be made in a flight visibility of at least one nautical mile, clear of all cloud, and within sight of the ground. Anyone attempting to descend below cloud with a base of 800ft is literally "dicing with death," especially with the high ground to the south of Croydon.

Your contributor should indeed be grateful that radar was able to bring him in. Perhaps his experience will bring home to all private pilots that there is more to this "flying for fun" than appears on the surface.

St. Albans, Herts. V.M.C. PRIVATE PILOT.

## Historic Military Aircraft: Some Queries

I HAVE just re-read the articles on the Sopwith Tabloid Schneider and Baby by J. M. Bruce, and find I can add two items to the performance figures published in your issue of November 29.

The climb of the Sopwith Baby (130 h.p. Clerget) was given as follows in the table of performances issued by the Air Board on January 24, 1918: Climb to 2,000ft, 2.7 min; climb to 6,500ft, 11.0 min.

Whilst on the subject of performances, I would like to query some of the figures given by Mr. Bruce in his series of articles on historic military aircraft. It is not that I think they were inaccurate, but that they were not always truly representative of the aircraft.

For example, in the concluding instalment on the Short seaplanes the figures for the Short S184 (240 h.p. Renault) are, I believe, taken from the trial report on machine N1135 built by Frederick Sage and Co. which was tested at the Isle of Grain on July 17, 1917.

The figures published by the Air Board were based on a test of N1090 (Isle of Grain, May 30, 1917) and these figures give, I think, a more average performance, i.e., for a gross weight of 5,560 lb the speed at 2,000ft was 69.5 knots or about 80 m.p.h.

Discrepancies between comparative test results are, of course, inevitable and seven S184s tested at Grain between March and September 1917 gave different figures. However, another source is the acceptance test-cards of production machines and reference to a dozen of these reveals that for a gross weight of in no case more than 4,700 lb these S184s did not exceed 81 m.p.h.

I appreciate that it is not always possible to obtain information on such machines, but I think the figures would be more valuable if the source were given.

I should also like to amplify two items mentioned in the history of the Short seaplanes. It was stated that Westland commenced deliveries in January 1916, and Phœnix the following month. In fact the first Phœnix 184, No. 8368, was despatched on January 21, 1916, and first flew at Great Yarmouth on January 28, 1916. The date of official acceptance was February 21, 1916. The first production batch comprised twelve machines, Nos. 8368 to 8379, and not eleven as stated. Lastly, I have always believed that the S184 was known, at least semi-officially, as the "Dover type" seaplane.

Leeds, 17. T. R. COLLICK.

### FORTHCOMING EVENTS

April 25. Institute of Navigation: "Use of Simulators for Training Navigators to Use Radar Equipment."
April 28-30. Institute of the Aeronautical Sciences: Astronautics Symposium: Denver, Col.
April 30. Kronfeld Club: Talks by H. C. N. Goodhart and D. H. G. Ince.
April 28-May 2. Institute of Metals: Golden Jubilee Meeting.
May 3. British Interplanetary Society: a.g.m.
May 4. Tiger Club: Aerobatic Competition, Sywell.
May 7. Kronfeld Club: "Flying in New Zealand," by Keith Wakeman.
May 7-17. Mechanical Handling Exhibition, Earls Court, London.
May 9. Helicopter Association: "Canadian Research in the Field of Helicopter Icing," by J. R. Stallabrass.
May 9-11. Channel Islands Aero Club: International Air Rally, Jersey Airport.
May 14. Kronfeld Club: "1958 World Gliding Championships," by Ann Welch.
May 15. R.Ae.S.: 46th Wilbur Wright Memorial Lecture: "Automatic Flight," by G. W. H. Gardner.
May 16. Institute of Navigation: "Principles of Inertial Navigation Systems," by E. W. Anderson.
May 21. Kronfeld Club: Debate, "The Golden Age of Gliding has now Passed."
May 24-26. Belgian Aero Club: Brussels Exhibition Rally.
May 24-26. Fréjus-St. Raphaël Aero Club: Provence Wines Rally.
May 25-26. S.M.A.E.: British National Model Championships, R.A.F. Station Waterbeach.
May 25-June 1. Aéro Club de l'Ouest: d'Angers Gliding Competition.
May 26. Tiger Club: Air Race: Sandown, I.o.W.
Sept. 1-7. S.B.A.C. Display and Exhibition, Farnborough.

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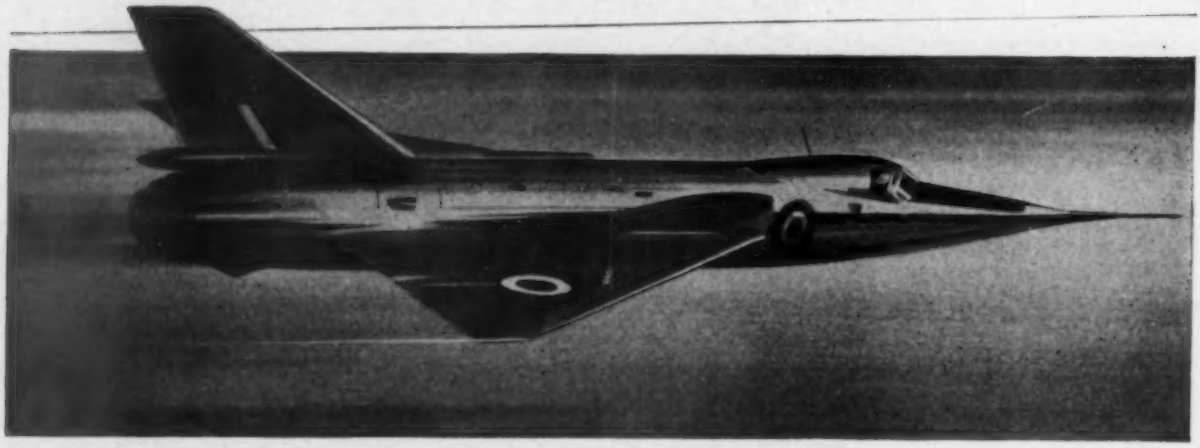

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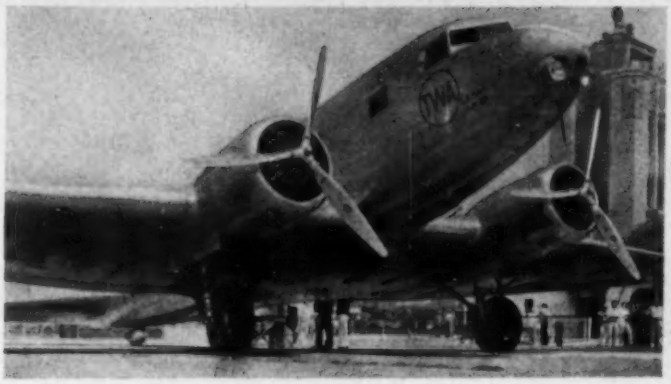


*"Work on the one and only DC-1 prototype started early in 1933 and the aircraft flew for the first time on July 1 of that year."*

# Origins of the Modern Airliner

## PART 2: DOUGLAS SETS THE PACE

By PETER W. BROOKS, B.Sc., A.C.G.I., A.F.R.Ae.S.

IN August 1932 T.W.A. (at that time Transcontinental and Western Air) approached Douglas with a requirement for a three-engined monoplane of metal construction which was to weigh about 14,000 lb and carry 12 passengers 1,000 miles at 150 m.p.h. At this time rumours of Boeing's promising work on their 247 for United Air Lines were no doubt reaching Santa Monica, and Douglas had become involved in the development of stressed-skin metal aircraft as a result of acquiring Northrop Aircraft as a subsidiary in January 1932. Northrop had produced a number of single-engined transport aircraft using this form of construction and Douglas had manufactured 38 of his Gamma design. Douglas now proposed to T.W.A. a twin-engined all-metal stressed-skin monoplane of rather similar general configuration to the Boeing 247 but incorporating several Northrop design features, including notably long-chord N.A.C.A. engine cowlings.

Work on the one and only DC-1 prototype started early in 1933 and the aircraft flew for the first time on July 1 of that year. Before this the passenger appeal of the Boeing 247 in service with United was already winning much of the traffic. Also, the 247 was showing clear signs of the lower operating cost characteristics which—according to Dr. E. P. Warner—later proved to be some 20 per cent lower per seat-mile than those of the Ford Trimotor of the previous generation of transports. Indeed, the 247 provided such a competitive threat on the domestic routes that T.W.A. opened negotiations with Boeing to buy a batch to be delivered after the first 20 to United. However, Boeing refused to give such deliveries because of their affiliation with United. Instead, they offered aircraft to T.W.A. for delivery after the full 60 for United. T.W.A.'s reply to this situation was to order 20 DC-2s from Douglas in August 1933. These aircraft were to be derived directly from the DC-1. The first flew on May 11, 1934. It was certificated, delivered and put into T.W.A. service in July 1934, 16 months after the first Boeing 247 went into service with United Airlines.

As a later design, the DC-1 and its DC-2 production derivative had a number of important advantages over the 247. In particular, their drag coefficient seems to have been significantly lower. In fact, it was soon apparent that the Boeing design was not competitive with the Douglas. The improved 247D was an attempt by Boeing to match the DC-2 in performance but its economic characteristics remained inferior. The Boeing design was eclipsed. Nevertheless, some 247s remained in service until as late as 1945. In all 75 were built, including three which were exported to Lufthansa—the first airliners of "modern" type to be sold abroad.

The DC-1 had a gross weight of 17,500 lb and carried twelve passengers. It was therefore appreciably larger than the Boeing. The DC-2's weight ultimately increased to 18,560 lb and the passenger accommodation was for 14, arranged singly each side of the central aisle at a seat pitch of 40in in a cabin 5ft 6in wide by 6ft 3in high. The DC-2's fuselage was made two feet longer than that of the DC-1 which, together with some rearrangement of the interior, made possible the incorporation of the extra row of passenger seats. The passenger cabin was not only six inches wider and three inches higher than that of the 247, but it was also completely unobstructed because the wing spars passed through the fuselage beneath the floor. The passenger seats in the DC-2 were 19in wide and there was an aisle of 16in between the seats. It is interesting that a three-abreast "high-density" layout for 18 passengers was visualized as an alternative when the DC-1 was designed, and two DC-2s are believed to have been operated with three-abreast seating in South Africa after the War. Although not normally used, the three-abreast DC-2 anticipated the high-density seating layouts adopted for the DC-2's larger descendant, the DC-3, in later years. In this case, the standard three-abreast layout of the DC-3 (in a fuselage 26 inches wider than that of the DC-2) was replaced by a four-abreast arrangement with pairs of seats each side of the central aisle.

The engines of the DC-1 and DC-2 were supercharged and geared Wright R-1820 Cyclone air-cooled radials which gave 710 h.p. each for take-off. Their N.A.C.A. long-chord cowlings were of very clean design and had a new type of cylinder baffling within the cowling (first developed by the United Aircraft and Transport Corporation) which greatly improved engine cooling. For the first time, more expensive fuel of a higher octane rating than was used for cruising was fed to the engines from a separate tank for take-off. Initially in the DC-1, the engines drove fixed-pitched propellers and there were performance penalties similar to those experienced with the early 247s. Hamilton Standard variable-pitch propellers were, however, standardized for production DC-2s. They gave an engine-out performance much superior to that of any previous twin-engined aircraft.

The all-metal structure, as with the Boeing, was of 24S aluminium alloy, but the wing design differed because it incorporated the multi-cellular principles used by the Northrop Company on their Alpha single-engine transport monoplane of 1930, which had also been one of the first American aircraft with a smooth metal monocoque fuselage. The important feature of this type of wing construction was that it incorporated a number of spanwise plate webs—the DC-1, 2 and 3 each had three—which took the vertical shear loads and, in conjunction with the stiffened metal surface of the wing, acted as the main structural member. The multi-spar arrangement reduced stress concentrations and ultimately made possible important weight savings. In this connection, however, it is interesting that (according to A. E. Raymond) the DC-1 airframe originally came out no less than 30 per cent over its design weight. Only the use of higher-powered engines and variable-pitch propellers—not projected originally—enabled the gross weight to be increased and the full structural efficiency of the design to be realized. Further "stretching" to give the DC-3 resulted in a highly efficient structure in that aeroplane.

As compared with the Boeing 247, the most important aerodynamic innovation in the Douglas aircraft was the addition of flaps, as used previously by Northrop on his single-engine transports. These were of the simple split trailing-edge variety, but they had an important effect on the approach speed. Flaps down, the stall was as low as 60 m.p.h., which was comparable with that of the Boeing in spite of the fact that, at 19 lb/sq ft, the wing loading was 15 per cent greater. The higher wing loading was undoubtedly an important factor in the improved performance and economy of the Douglas design.

Although the use of flaps was a vital factor in the success of the DC-1, these devices were not new. Indeed, simple camber-changing flaps—notably the Fairey patent camber gear—had been used on some production aircraft during the 1914-18 war.

The wing section of the DC-1 was NACA 2215 at the root and 2209 at the tip. That is to say, it was 15 per cent thick at the

*"As soon as the DC-2 was established in service its outstanding qualities became apparent . . . Swissair were among the first purchasers."*

## ORIGINS OF THE MODERN AIRLINER . . .

root and nine per cent at the tip. This thin section, which was made possible by the multi-cellular form of construction, helped to keep the centre-section below the cabin floor. By forestalling a general aerodynamic trend, it was to be an important reason for the long competitive life of the DC-2/DC-3 series. The DC-2 had a cruising speed at 8,000ft of about 170 m.p.h. on 50 per cent of take-off power and was about ten miles per hour faster than the Boeing 247D. It was also longer-ranged, offering a maximum practical stage-length of about 1,000 miles as against 750 miles for the Boeing. The DC-2 could carry its capacity payload for about 500 miles.

As soon as the DC-2 was established in service its outstanding qualities became apparent. The type sold rapidly and American Airlines and five other U.S. domestic operators followed T.W.A.'s lead and bought DC-2s. Abroad, K.L.M. and Swissair were among the first purchasers. They were followed by seven other foreign airlines. K.L.M. used the DC-2 for its services between Europe and the Far East. The performance potentialities of the DC-2 and, to a lesser extent, of the Boeing 247D — actually the first 247D — were dramatically demonstrated when an aircraft of each type took part in the historic MacRobertson Race from England to Australia in October 1934. The two "sedate commercial transports" gave performances almost as spectacular as those of the specially-built racing aircraft with which they were in competition. The DC-2 flew from Mildenhall to Melbourne in an elapsed time of 3¾ days which compared with just under three days taken by the winning de Havilland Comet racer.

By the end of 1934 Douglas were producing ten DC-2s a month, and the hundredth was delivered to American Airlines on June 5, 1935. A total of 220 of these aircraft was built (160 for the airlines) before the type was succeeded in production by the larger DC-3 in 1936. The initial development of the DC-1 and DC-2 series is said to have cost rather more than $300,000 (£60,000). Production aircraft were sold at $65,000 (£13,000) each and break-even on the project is believed to have been reached after 75 aircraft had been built. Low as the prime cost of the DC-2 seems today, it was an expensive aeroplane compared with the Fokker and Ford Trimotors of the previous era, which had cost between $35,000 and $38,000 (£7,000-£7,600) each.

While Boeing and Douglas were engaged in their competitive struggle over the first generation of "modern" transports, a third contender appeared on the scene. In the second half of 1933, soon after the Boeing 247 had entered service and the DC-1 had flown, the Lockheed Aircraft Company at Burbank in the Los Angeles area started building their L-10 Electra. The Electra first flew on February 23, 1934, and quickly proved itself to be a worthy contemporary of the DC-2. It had an initial gross weight of 9,000 lb with accommodation for eight passengers and was therefore a size smaller than the Boeing 247 and considerably smaller than the DC-2. At this stage in air transport development such a small vehicle was still attractive for scheduled operations because of its low aircraft-mile costs, and the Electra was sold to many commercial operators. The first Electras went to Northwest Airways and the second batch to Pan-American. About 150 were built, together with 114 L-12s, 112 L-14s and 624 L-18s (the majority of which were supplied to the Services). All these types derived from the original L-10 design and had passenger capacities of up to 14, or 21 in high-density layouts. Production was at a rate of 35 aircraft per month by 1939.

The Electra was of the same all-metal (24S light alloy) stressed-skin construction as the Boeing and Douglas and, like them, was a cantilever low-wing monoplane with a rounded-section fuselage and with the passengers accommodated in two rows each side of a central aisle. The wing structure, however, featured a one-spar method of construction—a type which has proved less satisfactory from the fatigue-resistance aspect than the Douglas multi-spars. A design innovation was the adoption of duplicated vertical surfaces mounted at the tips of the tailplane. This arrangement started a fashion in design to which Lockheed adhered right down to their Constellation series with its triple fins and rudders.

*First flown in February 1934, the Lockheed Electra "quickly proved itself to be a worthy contemporary of the DC-2."*

By now as a matter of course, the Electra and the designs which evolved from it had flaps, variable-pitch propellers and retractable undercarriages. These Lockheed aircraft were rather faster than their Boeing and Douglas contemporaries; and the Lockheed 14, which flew for the first time on July 29, 1937, was particularly notable because it introduced the highly effective Fowler area-increasing flaps, which have since been widely used. This type of flap had been first tried in 1927 and was demonstrated on a Pitcairn design in the Guggenheim International Safe Aircraft Competition of 1929. These flaps in the L-14 made possible a wing loading of 32 lb/sq ft while holding down the stalling speed to 69 m.p.h. The Lockheed 14 was the first aircraft in airline service to have two-speed superchargers, feathering propellers and under-floor freight holds—developments which were to become standard features of subsequent types. The type 14 was later "stretched"—by lengthening the fuselage to take another row of seats—into the L-18 Lodestar, which first flew on September 21, 1939.

Tracing the story of the Electra and its successors has brought this account chronologically past what was perhaps the most significant of its milestones. This was the appearance of the famous DC-3, undoubtedly the most successful airliner which has so far been produced. The DC-3 was the logical development of its predecessor, the DC-2.

Early in 1935 discussions started between Douglas and one of their leading DC-2 customers, American Airlines, about a scaled-up version of the earlier aeroplane to be used as a sleeper transport on the transcontinental routes in succession to the Curtiss Condor biplanes then in service. It was to provide sleeping accommodation for 14 passengers. Work started on the first DST ("Douglas Sleeper Transport," later to become famous as the "Day Plane" DC-3) in mid-1935 and the prototype flew for the first time on December 22 of the same year.

Closely similar to the DC-2, being built of the same materials and employing basically the same structure, the DC-3 retained the multi-spar wing and tail, and this form of construction was—fortuitously—to play an important part in the airframe's outstanding fatigue-resistant and fail-safe qualities. Individual DC-3s were to fly as much as 50,000 hours without major rebuild and thus give evidence of a durability which more recent designs find it hard to rival. The wing area of the DC-3 was increased about five per cent over that of the DC-2 and the span was raised from 85ft to 95ft by the addition of new and pointed tip sections. The wing section thus remained NACA 2215 at the root and became NACA 2206 at the tip. Wing loading went up from 19 to 24 lb/sq ft. The widened and lengthened fuselage would take 21 day passengers arranged two-abreast on one side of a 19in aisle and in single seats on the other with seats 21in wide. Even with two-and-one seating the passenger was offered substantially more space than in the DC-2, the internal section of the cabin being 7ft 8in wide by 6ft 6in high. An unexpected aerodynamic advantage of the larger fuselage was that it had a slightly better drag coefficient than that of the DC-2.

Replacing the 700 h.p. Cyclones of the DC-2 with Cyclones or Twin Wasps of 1,000/1,200 h.p., enabled the loaded weight to be raised initially to 24,000 lb and later, particularly in military service, to much higher figures. The higher engine powers were largely made possible by the rapid improvement in fuels, which contributed much to engine development during this period. The result of these changes was an aeroplane which had no contemporary rival and which established new standards of operation wherever it was used. According to Dr .Warner, its operating cost per seat-mile represented an improvement of no less than 25 per cent on that of the Boeing 247D.

The first DC-3 (a DST sleeper version) was delivered to American Airlines on July 11, 1936, and other U.S. operators also soon ordered the type. The DC-3 covered the 2,600 miles from

*The DC-3, which first flew in late 1935, "was to bring air transport through its most critical formative years."*

*The D.H.95 Flamingo "might have sold in numbers but for the war."*

New York to Los Angeles overnight with three or four stops in 16 flying hours and made the return trip in 14. The total elapsed time for the one-way journey was, however, more usually about 24 hours. This compares with the eight-hour non-stop schedule achieved today by those descendants of the DC-3, the DC-7 and the Super Constellation.

The sales success of the DC-2 had been outstanding; that of the DC-3 was phenomenal. Orders poured in from all over the world—150 had been ordered, and most of these delivered, by the end of 1937. The type soon came to be accepted as a universal standard both abroad and on the United States domestic routes, now expanding at the tremendous pace which was soon to give them a proportion of traffic—still maintained—which is equal to that of the rest of the world's airline operations taken together.

Before the introduction of the DC-3 the U.S. domestic airlines were covering, on average, less than two-thirds of their total costs. The DC-3 raised this proportion to more than 80 per cent before the United States entered the war. Under artificial conditions of military contracts, the airlines made profits during the war years, but it was not until 1950 that the U.S. domestic airlines taken together finally achieved full profitability without subsidy. By then they were using the "DC-4 generation" equipment which will be discussed later. While they were working towards a profitable state between 1936 and 1950, the average fare charged was reduced by more than 40 per cent, from over tenpence to under sixpence per passenger-mile, calculated at today's money values.

Most of the American domestic airlines eventually adopted the DC-3 and the type provided the basis for their operations throughout the war. Already, by 1938, the DC-3 was carrying 95 per cent of American domestic air traffic. By the time the U.S.A. entered the war at the end of 1941, more than 800 DC-3s had been produced (450 for the airlines) and licences to build the type had been sold to Britain, Russia, Japan and Holland. Orders had also been placed for large numbers of various military transport versions and more than 10,000 of these were built before the end of the war. Nearly 1,500 are still in scheduled airline service today, as well as many more on charter work and in use as military transports.

Douglas are believed to have spent about $1,200,000 (£240,000) on the initial development of the DC-3. The purchase price of the production aircraft was between $90,000 and $115,000 (£18,000-£23,000), of which about $20,000 (£4,000) was for the engines, and break-even on sales is believed to have been reached at about the 50-off point.

The DC-3, as the most important trunk-route equipment—effectively supported primarily by the Lockheed series of smaller twin-engined types—was to bring air transport through its most critical formative years. By the middle 1930s, however, it was becoming clear that larger and longer-range equipment would be needed in the coming decade for the next stage of development. The American industry was to retain its initiative in this phase by again achieving a technical ascendancy over the rest of the world with its four-engine long-haul equipment.

Before turning to the development of the first truly long-haul transport aircraft capable of carrying worthwhile payloads over the oceans between the continents, it is desirable to consider the effect of the Boeing, Douglas and Lockheed transport aircraft successes in the 1930s on the aircraft industries of other nations. As was to be expected, the obvious success of the American all-metal monoplanes soon stimulated similar designs in all the other major aircraft-producing countries.

In spite of being well behind the United States in swinging over to the aerodynamically clean all-metal stressed-skin monoplane, Britain and Germany at this time probably led the world in the development of military aircraft, their armament and their ancillary equipment. The aircraft industries of the two countries were, of course, heavily involved in maintaining this lead, which they succeeded in doing until nearly the end of the Second World War, but in the earlier 1930s their preoccupation with military developments had not become as complete as it did later. As a result, several firms in both countries started studying projects generally similar to the Boeing 247 soon after details of that aircraft were published. In May 1933 the Bristol Aeroplane Company prepared its Type 135 project, which was for an eight-passenger all-metal monoplane with two Aquila sleeve-valve radial engines. This design was not built, but it led to the Types 142 and 143, both of which were projected in April-May 1934 and later produced in prototype form. The Bristol 142, the famous *Britain First* prototype of the Blenheim bomber, carried six passengers at 285 m.p.h. on the power of two 645 h.p. Mercury VI engines and would hardly have made an economic airliner.

The Type 142 was built as a high-speed "executive transport" to the special order of Lord Rothermere, and it first flew on April 12, 1935. A commercially more practical version was the

*"Only about a dozen DC-5s were built, but they had the distinction of being the first airliners with a tricycle undercarriage to go into service."*

Type 143, which flew on January 20, 1936. This had a larger fuselage to carry eight passengers on two 550 h.p. Aquila IV sleeve-valve engines. It was not developed, largely because of the firm's pre-occupation with military orders. Although two years behind the equivalent Lockheed Electra, the Bristol 143 might have achieved worthwhile sales in more favourable circumstances.

Amongst other British manufacturers who interested themselves in all-metal stressed-skin transport aircraft developments were de Havillands, whose project work in this field culminated in the D.H.95 Flamingo, a high-wing monoplane of DC-3 capacity but smaller wing area (651 sq ft), which made its first flight on December 28, 1938, and subsequently went into limited production. This design had a partly fabric-covered wing with a single D-spar and, like the unsuccessful Douglas DC-5, probably suffered some weight-penalty from its high-wing layout. It might, nevertheless, have sold in numbers but for the war. It should be observed in passing that only about a dozen Douglas DC-5s were built, but they had the distinction of being the first airliners with a tricycle undercarriage to go into service.

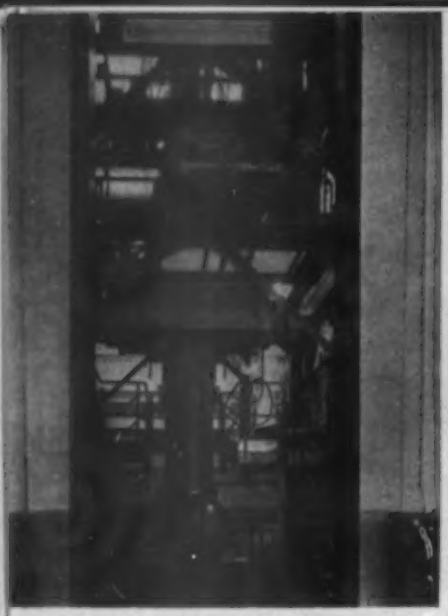
In Germany two designs with roughly the wing area and capacity of the Boeing 247 were projected for Lufthansa in 1934. They materialized in 1935 as the Junkers Ju 86 and Heinkel He 111 prototypes—both were later to be better known as bombers. They followed the Ju 60 and He 70 single-engine transports which had been inspired earlier by the single-engine American designs. Both the He 70 and He 111 were built in small numbers but neither went into extensive use as transports. The Ju 60 also was not produced in quantity but the Ju 86 was built and used in some numbers as a transport aeroplane, including a number which were exported.

France, Italy, Russia and Japan also produced designs in broadly the same category and using generally similar structural techniques, although in most cases with partial fabric covering of the wing. Some of these aeroplanes went into limited production but none of them came near rivalling the success of their American forerunners. The United States had certainly won the first round in the development of the "modern" airliner.

It is important to consider why America had such a monopoly in pioneering the successful transport aeroplane. One might have expected the lead to have been taken, or at least the American challenge to have been immediately and effectively accepted, by both Great Britain—which had played a leading rôle in civil aircraft development up to that time—and Germany, which had pioneered the successful configuration and much of the constructional method used by the Americans. These countries were both actively developing long-distance air services in the early 1930s and therefore had the incentive to obtain the best aircraft for the purpose.

It would seem that the American initiative sprang largely from the competitive spirit within the United States airline industry, where there was fierce competition between the various operators, some of whom had close affiliations with aircraft manufacturers. The result was that several constructors were set against one another in developing and improving the new equipment and in building and selling it in quantity. Although, under the U.S. Air Mail Act of 1934, affiliations between manufacturers and airlines were thereafter prohibited by law, there is no doubt that competition between the American airlines, and the competition between manufacturers in the development of transport aircraft which this generated, has been—and continues to be—a major reason for American leadership in this field.

(*To be concluded*)



*Three aspects of production of large titanium ingots by the Kynoch Works of I.C.I. Metals (see first news-item below): Left, one of the furnaces; the foreground doors are closed during melting. Centre, the first 4,200 lb titanium ingot to be melted in Europe. Right, remote controls include an optical system.*

# THE INDUSTRY

## Titanium-melting Progress

EUROPE'S largest titanium melting furnace came into operation recently at the Kynoch Works of I.C.I. Metals Division at Witton, Birmingham. It is one of three furnaces supplied to the division by W. C. Heraeus G.m.b.H. of West Germany for the production of double-melted ingots of up to 4,200 lb in weight, by the consumable-electrode arc melting process. The furnaces were delivered in January and the first one-ton ingot appeared a little over two months later; then within a few days an ingot weighing 4,200 lb—the largest ever produced outside the United States—was successfully achieved.

Ingots of such a size offer the titanium user two important advantages: they make possible the rolling of slab into long coils by strip-rolling techniques; and yield is increased by decreasing surface/volume ratio. (The possibility of reducing process scrap is, of course, valuable; because titanium is still a relatively expensive metal.)

The melting current employed at Witton is an extremely high one, and the furnace normally operates at a high degree of vacuum, a pressure of under 10 microns Hg being maintained throughout a melt. There are also facilities for melting under a reduced pressure of an inert gas.

Features which are particularly useful are those which reduce "down time" between melts and therefore effect big improvements in furnace utilization. One such device enables the first-melt ingot to be withdrawn into the upper part of the furnace and held in vacuum while the larger-diameter crucible necessary for the second melt is fitted. Another device allows the second-melt crucible, containing the double-melted ingot, to be sealed by a plate valve and withdrawn from the furnace—which can then be prepared for a second melt—for cooling.

The hazards associated with titanium melting are now understood and the I.C.I. installation incorporates, it is stated, "the most advanced measures yet devised to ensure safe working."

## Extreme-temperature Chamber

TEMPERATURES of 300 deg (F) above zero or 100 deg below can be obtained in the new "high-low" temperature chamber at the environmental test laboratories of Canadian Applied Research, Ltd., O'Connor Drive, Toronto. Low temperatures are obtained by using a 35 h.p. compressor and high ones by means of a 9kW heating element. When the tank (which is 3ft wide, 3ft deep and 8ft long) is filled with brine, ethylene glycol or alcohol, it is possible to run low-temperature immersion tests—an example being a check on the performance of heating elements in rubber de-icing boots. The length of the box facilitates the testing of a large object, such as a section of wing leading-edge; and a feature of the test chamber—which has cost $24,000—is its ability to maintain a constant temperature as low as 70 deg (F) below zero, even though 5kW is being dissipated in the fluid.

## High-temperature Laminate

A NEW material with the trade-name "Astrolite" has been announced by the British Refrasil Co., Ltd., of Stillington, Co. Durham. It is stated to be a laminate which, incorporating a high-temperature resin and Refrasil materials, will for short periods withstand temperatures of about 5,000 deg F.

During a test a half-inch-thick Astrolite laminate resisted a flame temperature of 4,600 deg F for 2 min 22 sec before finally burning through, compared with a similar thickness of stainless steel which lasted only 1 min 22 sec.

When Astrolite is exposed to extremely high temperatures a layer of its exterior plastic burns off, leaving an undersurface of Refrasil (silica fibres) so arranged that these will not be easily removed by the gas stream. At about 3,000 deg F the fibres begin to soften; but as melted silica is a viscous substance it remains in position until evaporated. The action of vaporization draws heat from the remainder of the laminate and assists in cooling.

# IN BRIEF

Formerly a principal scientific officer with the Admiralty Signal and Radar Establishment and prior to that production manager for Dawe Instruments, Ltd., Mr. Gordon A. Spencer, A.R.T.C., M.I.E.E., has joined Andec, Ltd., the Reading electronic engineers, as assistant to the director. The company also announce the appointment, as chief electronics engineer, of Mr. Hilary F. C. Williams, B.Sc., until lately assistant chief engineer to Racal Engineering and prior to that a development engineer with Cossor.

* * *

A brochure describing and illustrating the Newton system of hydraulic clamping has been published by Power Jacks, Ltd., Maylands Avenue, Hemel Hempstead, Herts.

* * *

Wolf Electric Tools, Ltd., have acquired an additional factory—their fifth. It is on the Slough Trading Estate.

*Appointed contracts manager of the Bracknell division of the Sperry Gyroscope Co., Ltd., is Mr. L. N. Lupton, M.A., F.R.Ae.S.*

*Appointed executive vice-president and general manager of Orenda Engines, Ltd., Mr. Earle K. Brownridge was last year awarded the McCurdy Trophy—presented annually by the Canadian Aeronautical Institute for outstanding contributions to Canadian aviation—and elected an Associate Fellow. He joined A. V. Roe Canada, Ltd., in 1945.*

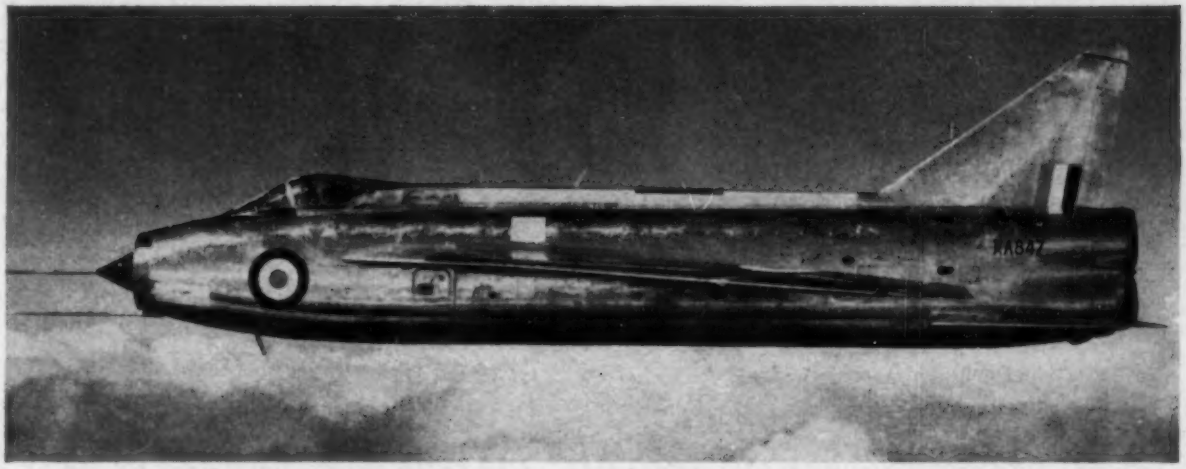
K2 Wadpol impregnated polishing wadding (Valay Industries, Ltd., 186 Campden Hill Road, London, W.8), is supplied in 7 lb cans and not, as recently stated, in 7 gal cans.

* * *

A new pressure control valve (Type RV53/1) for the control of air tapped from the main powerplants in the Comet 4 for emergency fuel jettisoning has been developed by the Hymatic Engineering Co., Ltd., Redditch, Worcs. The body of the valve, of light-alloy construction and resistant to temperatures of up to 365 deg C, distributes the airflow into three channels. Two of these terminate in relief-valve assemblies and the third carries the by-pass flow, up to a maximum of 140 cu ft/min, to the aircraft pressure system.

## FOR BUILT-IN SAFETY AND ECONOMY...

The ENGLISH ELECTRIC P.1B has the basic safety factor of all twin-engined aircraft. In addition, all its powered control systems, and their power supplies, are duplicated. It can, if required, extend its range by cruising on one engine alone, for it poses no asymmetrical flying problems. And it can go supersonic in level flight without re-heat.



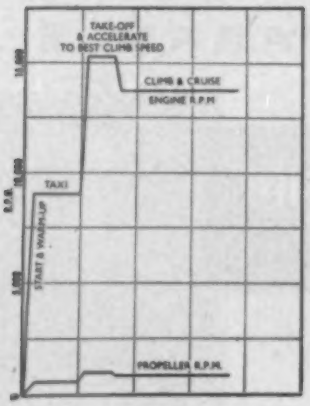
## ...THE P.1B IS INCOMPARABLE

'ENGLISH ELECTRIC' aircraft

THE ENGLISH ELECTRIC COMPANY LIMITED
MARCONI HOUSE · STRAND · WC2

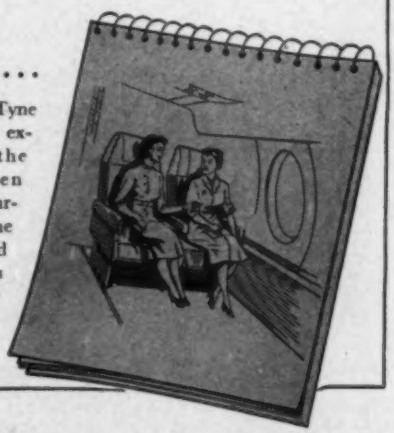
# *Yes, with the* VANGUARD

The many problems of noise nuisance on and around airfields will be reduced by the introduction of the Vickers Vanguard. Noise from the four Rolls-Royce Tyne propeller-turbines is remarkably low for an aircraft of the Vanguard's size and power. This will be of particular advantage when operating from airfields in or near residential areas. A lower noise level on the airport will also increase efficiency in the administrative blocks and improve the broadcasting of passenger information. The lower interior noise and vibration will win approval from operators, pilots and passengers.




## For your notebook...

Gases from the Tyne engines are only exhausted after the power has been absorbed by the turbine. This is one reason for reduced noise. The other is the low propeller tip speed.



**VICKERS VANGUARD**

FOUR ROLLS-ROYCE TYNE PROPELLER-TURBINE ENGINES

VICKERS-ARMSTRONGS (AIRCRAFT) LIMITED WEYBRIDGE SURREY

TGA AT541

*Sabena, Europe's major scheduled helicopter airline, is operating this Westland Widgeon for the duration of the Brussels Fair. It will be used mainly for sightseeing tours and charters, and is the first Widgeon to be operated by an airline.*

# CIVIL AVIATION

## AIR TRANSPORT IN 1957

EACH year at about this time the International Civil Aviation Organization publishes its annual report for the previous year. The report for 1957, which is now available,* follows the form of previous years' editions and, as usual, the references to traffic growth and financial progress comprise the most generally interesting section. Salient points are summarized as follows.

Scheduled world air traffic increased in 1957 by about 14 per cent. This compares with 14.4 per cent in 1956, and 16.6 per cent in 1955. The actual amount of traffic carried was 9,330 million tonne-km: this comprised 82,000 million passenger-km (7,210 tonne-km); 1,680 cargo tonne-km; and 440 million mail tonne-km.

The largest *passenger* traffic gains (more than 25 per cent) were recorded in the Far East; European passenger traffic increased by about 21 per cent, and in the U.S.A. by about 13 per cent.

The extent to which low-fare traffic contributed to the increased volume is, say I.C.A.O., difficult to assess: the estimate is that in the U.S.A. 42 per cent of total passenger traffic (domestic and international) was tourist-class. (Surprisingly, still only 36 per cent of U.S. domestic passengers pay coach fares; the international proportion is about 66 per cent.)

Figures for the North Atlantic show that 73 per cent of the passenger business (968,146 scheduled) was tourist-class. A total of 1,018,784 passengers were carried both ways across the North Atlantic, the balance being mainly made up of low-rate westbound immigrants. Airline passenger traffic on this route now approaches that carried by ships, whose total in 1957 was about 1,027,000 passengers.

On the financial side, I.C.A.O.'s report says: "There were strong indications during 1957 that, not only was the financial situation of the world's airlines not improving at the same rate as traffic was growing, but that indeed it was facing serious deterioration."

Financial returns are not yet complete, but the report tentatively estimates that the operating ratio—revenues as a percentage of expenses—was 101.2, compared with 102.5 in 1956.

Firm figures are given for revenues and expenses in 1956; tentative figures for 1957, which will no doubt become more definite during the next few months, are: revenues, about $4,100 million; expenses, about $4,050 million. Expenses rose more rapidly than costs for the second year in succession, but profitability was reduced also by lower load factors—an estimated 58.3 per cent in 1957 compared with 59.3 per cent in 1956, i.e., one full point down.

**"Annual Report of the Council to the Assembly for 1957, I.C.A.O.," H.M. Stationery Office, London. Price 5s 2d.*

## OFF TO BERMUDA

LAST Sunday morning at Blackbushe there occurred a significant event in the development of British private-enterprise air transport. A Viscount 805 of Eagle Aviation, bearing the Bermuda flag and registration VR-BAX, and with "The Bermuda Airline" painted above the passenger door, left to take up permanent residence in the British colony. There, starting on May 2 by which time a sister aircraft will have followed, the aircraft will inaugurate a new British service to New York.

The significance of this service is that it will mark the first occasion on which a British independent has found an opportunity to compete in scheduled operations with nationalized Corporations. Bermuda is served by B.W.I.A., a B.O.A.C. subsidiary.

The background to this new service was discussed in *Flight* of March 7. Eagle Aviation, aware of the opportunity for Bermuda - New York business, though debarred by the Air Corporations Act from scheduled operations except under an "associate agreement" with B.O.A.C., formed a subsidiary in April 1957 known as Eagle Airways (Bermuda), Ltd. This company, having been incorporated under Bermuda law, was therefore free to apply for rights to operate scheduled services to the U.S.A. and Canada, the main sources of Bermuda's tourist business. This move met with the approval of the Bermuda Government, who have long felt the need for more British-operated air services to and from the colony (more than three-quarters of the island's visitors, though admittedly mostly American in origin, are carried by American airlines, PanAm and Eastern).

The terms of the Anglo-U.S. air agreement permitted the designation of a second British carrier on the Bermuda route; the Civil Aeronautics Board accepted the designation of Eagle Airways (Bermuda), and it is to the credit of the U.K. Government—who negotiate traffic rights concerning the British colonies—that no political obstacle was put in the way of the independent's venture.

Eagle will start operations on a once-daily basis to New York. This frequency compares with that offered at present by B.W.I.A. Eagle seem quietly confident that, operating the most modern aircraft on the route, they will more than hold their own. Indeed, Mr. Harold Bamberg, Eagle's managing director, is already considering the possibility of extending the service to Toronto in three months' time, and confirms that his airline is also studying the potentialities of Britannias or Comet 4s for the route. The transfer of the two Viscount 805s from the parent Eagle company to the Bermuda associate will also, Mr. Bamberg says, mean the probability of more Viscount orders for the operation of Eagle's scheduled services from the U.K. (Photograph: page 557).

## TOO MANY B.O.A.C. ENGINEERS

ACCORDING to the engineering trade union leaders, a "head-on clash" is imminent between the management of B.O.A.C. and its engineering staffs. One union official is reported to have said: "This is the beginning of a war—and a big one."

There is no doubt that if B.O.A.C., following their recent inquiry into the size of their maintenance and engineering staffs, go through with plans to dismiss a large number of workers (perhaps as many as 3,000 over the next two years) both B.O.A.C. and B.E.A. may well be grounded by a strike. Already there has been a ban on B.O.A.C.'s engineering staff working overtime.

B.O.A.C.'s first public expression of doubt about the productivity of its staff came last September. In a letter to the employees, Mr. Basil Smallpeice, managing director, said: "Unless we can soon improve our methods so as to produce about double the hours for the same cost, we shall never be fully competitive."

There followed a management survey of the situation (undertaken by Mr. Charles Abell, chief engineer) in which the Corporation's engineering productivity and costs were compared with those of other airlines, including, it is reported, K.L.M. and PanAm. The Minister of Transport, Mr. Harold Watkinson, was apparently closely concerned: in Parliament on January 27 he said: "I have had talks with the chairman . . . and we agreed that the Corporation must now make a great attempt to cut down its internal costs. These are very high, and a constructive effort must be made to put the financial position right."

Whether or not the unions have been kept informed, or to what extent they co-operated in the survey, is not clear: but there is no doubt that they have been well aware of what has been going on. Until last week, however, they made no official expression of their views. Mr. Clive Jenkins, national officer of the Association of Supervisory Staff Executives and Technicians, then said: "My union, in view of the phenomenal increases in productivity within B.O.A.C. over the past few years, has decided that it would not be prepared to accept redundancy."

The fact is that B.O.A.C.'s engineering productivity and costs have always compared unfavourably with those of competing international airlines. This *Flight* comparison of maintenance and overhaul costs in pence per tonne-km shows the relative positions as follows (the figures are for 1956, the latest yet available; currency conversions are at the I.A.T.A. exchange rate): —

B.O.A.C., 6.7; Air France,* 6.2; T.W.A.† 4.6; Swissair,* 4.5; PanAm, 3.9; S.A.S.,* 3.5; K.L.M.,* 3.1. *Inflated by short haul operations. †International operations only.

Quite clearly, a serious situation is looming, and though there will be much sympathy for the many skilled B.O.A.C. engineers whose livelihood is now threatened, it is to be hoped (to quote Mr. Smallpeice) that "they will come to appreciate, however reluctantly, the necessity for what has to be done." B.O.A.C.'s total engineering force is 6,200 men at London Airport, and 1,100 men at Treforest.

*See "Straight and Level," page 577.*

# CIVIL AVIATION . . .

*Within the space of little more than a week four historic transport "firsts" have taken place. From left to right, Fairchild's first F-27 flew at Hagerstown on April 15 (production deliveries will begin in June); the first Douglas DC-8 was rolled out at Long Beach on April 9; the first production Sud Aviation Caravelle was completed at Toulouse in the first week of April; and the Bristol Britannia (as ordered by Northeast) received its American airworthiness certificate on April 10.*

## DEMOCRATIC AIRLINES

BY giving airline employees a financial share in the ownership of their company, airline managements can inject into the body industrial something of that feeling of participation which is so essential a feature of successful democratic institutions. The Brazilian airline VARIG has carried this practice further than any other major airline, over 80 per cent of its capital being held by employees (51 per cent in an Employee Foundation and 30 per cent in private holdings).

Another example is Butler Air Transport, which since becoming an Australian public company in 1952 has had a significant share of its capital vested in an employees' trust scheme. By maintaining a voting control over the company, this trust prevented A.N.A. —which had acquired a majority shareholding in Butler—from absorbing the company; but since A.N.A. was taken over by Ansett, efforts to wrest control from the employees' trust have been intensified. Although Mr. Reg Ansett has become chairman of Butler and the company's founder, Mr. Arthur Butler, has now retired, the precise legal significance of the employees' stock of shares remains vague.

The latest company to embark on a staff-shareholding scheme is Middle East Airlines. Employees who have been with M.E.A. for at least one year are entitled to purchase the company's shares at £L.200. This figure (twice the par value) has been assessed by the External Auditors to be rather below the market value. Employees are guaranteed a minimum annual dividend of five per cent on the par value of the shares. To encourage investment, employees participating in the scheme will receive one free share in every four, and will also be allowed a discount ranging from 5 to 25 per cent, according to years of service. Shares can be purchased through monthly deductions from salary, dividends being paid on the full value of the shares and not on the instalments already paid. To protect participants from a possible fall in the value of their shares, the company has agreed that these may at any time be returned at a guaranteed price of £L.200. The scheme is financed by the International Traders (Intra) Bank at Beirut, which has acquired 18 per cent of M.E.A.'s recently increased capital for this purpose.

## SIKORSKY v. CONVAIR

THE latest I.C.A.O. *Bulletin* (Vol. XII, No. 10) contains some interesting comparative information given by M. Nottet, Belgium's Director-General of Civil Aviation, on Sabena's S-58s and Convair 440s.

Relating hourly productivity to horsepower, M. Nottet showed that the ratio for the Metropolitan was 2.4 times more favourable than the helicopter. Employing 1,525 h.p., the 12-seat, 106 m.p.h. S-58 produced 0.81 seat-miles per hour. The Metropolitan, in comparison, achieved an hourly seat-mileage of 1.94.

Although Sabena use a seven-year depreciation period for both fixed- and rotary-wing aircraft, the seat-mile cost of S-58 depreciation (despite annual utilization at 1,750 hr) is twice that of the Convair 440, the figures quoted by M. Nottet being B.Fr.0.95 (1.6d) and B.Fr.0.44 (0.8d), respectively.

But the helicopter showed at its worst in the case of maintenance costs. The rate for the S-58, B.Fr.2.40 (4.1d) per seat-mile, was ten times that of the Metropolitan.

Over short distances the costlier vehicle offers a clear time advantage, however. City-to-city journey time between Brussels and Cologne is 1 hr 20 min using the S-58, 2 hr 30 min by conventional aircraft, and 4 hr 38 min by train. Equivalent journey times for Brussels - Paris are 1 hr 50 min, 2 hr 40 min and 3 hr 00 min. Sabena's experience with the S-58 has suggested that this helicopter can offer shorter journey times on distances up to 217 miles. A circle of such a radius drawn about Brussels would embrace a population of 72 million inhabitants—the highest concentration of population in the world, with 58 cities of more than 100,000 inhabitants and 25 with more than 200,000 inhabitants and including Paris, London, Amsterdam, Cologne and Frankfurt as well as the large concentration of cities in the Ruhr area. A machine capable of cruising at 125 m.p.h. would allow this distance to be extended to 370 miles—thus including Geneva, Hamburg, Manchester, Stuttgart and Zurich.

## FROM TRACTORS TO TILAPIA

IMPORT restrictions on British tractors in France led the Standard Motor Company to establish a subsidiary, Société Standard Hotchkiss, in Paris. The subsidiary, in which Hotchkiss (manufacturing engines) and Massey Harris Ferguson (responsible for marketing) also have shares, is now France's leading manufacturer of tractors, producing them at the rate of 100 per day. The threat of a Common Market from which the U.K. were excluded has led Standard-Hotchkiss to open up another factory at Beauvais. The volume of spares sent from Standard's Manchester plant is already heavy, and expansion of Beauvais output will lead to a sharp increase in the need for cross-Channel transport.

Massey Harris Ferguson have been conducting a survey into this market, and have concluded that "use of the Silver City Roadair service saves us a whole week in time and, taking packaging into consideration, saves us also about £4 per ton in transport costs." This conclusion has led them to transfer their custom from sea to air services.

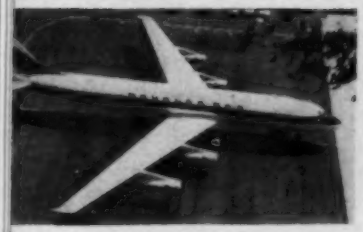
It is not only in Europe that distributors are becoming increasingly aware of the advantages to be gained from air freighting. In Equatorial Africa the aeroplane has been found to be the best way of transporting fish. Fresh water bream, Tilapia Nilotica and Tilapia Leucosticta, are caught in abundance in Lake George by the Uganda Fish and Marketing Corporation (a subsidiary of the Colonial Development Corporation) and are filleted, packed and refrigerated in a nearby factory. TUFMAC then arranges special charter flights with East African Airways direct to the main markets at Nairobi and Dar-Es-Salaam. For flights up to six hours no refrigeration is needed on board if the fish are immediately put back into cold storage on arrival.

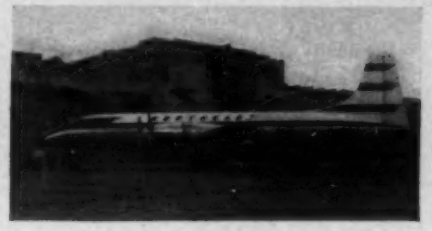
## BALANCING THE BUDGET

IN a recent lecture the U.S. Under-Secretary of State for Transportation, the Hon. Louis S. Rothschild, described the course his department was adopting in covering the mounting cost of providing airways within the U.S. This cost, representing four-fifths of the total C.A.A. budget, was originally estimated to reach $250m over five years, but had now risen to $800m over six.

On the basis of physical use, about three-eighths of the total airways costs were attributed to the military services. As a matter

*Recent visitors to Weybridge included a party of Polish airline and aviation ministry officials. During the visit, made on April 11 following the inaugural direct flights by B.E.A. and LOT between London and Warsaw, the LOT representatives showed great interest in the Viscount and Vanguard. The party included the vice-minister of transport, J. Rustecki (wearing hat); the director of the civil aviation department at the ministry of transport; J. Zwierzynski (right); and the director of Polish Airlines LOT, A. Skala (with hand out). Facing the camera is Mr. Geoffrey Page of Vickers.*





of policy, an increasing share of the remaining costs would be contributed by private users: in the initial stages, this share would be 60 per cent, but would later rise to 80 per cent. The main instrument used in recovering expenditure on airways will be fuel tax. In the case of Avgas this will rise from two cents per gallon at present to 3½ cents next year and by further steps to 6½ cents in another four years. Prices for turbine fuel will also include a similar proportion of Federal tax.

## STRIKE AVERTED

AFTER the recent rejection by the Industrial Court of a 15 per cent wage claim submitted by the employees' side of the National Joint Council's Catering Panel on behalf of the Corporations' cabin staff, it seemed that a strike was imminent.

At a mass meeting convened by the Transport and General Workers' Union (representing about 800 of the 1,244 stewards and stewardesses of B.O.A.C. and B.E.A.), 150 members voted unanimously to terminate their employment contracts. If no replies are received from the Corporations, another meeting will be convened on May 6 to consider further action.

## FOR THE PASSENGER'S POCKET

WRITTEN by Derek Harvey and published by Cassell are the first two books in a new series, *Famous Airliners*. The aircraft dealt with, appropriately enough, are the Viscount and the Britannia.

For whom are these books intended? The question is not easy to answer. Priced at ten shillings and sixpence each, they are not children's books, and they do not claim to be technical works, although they are fairly comprehensively illustrated with technical drawings—many of which are acknowledged to *Flight*. Most probably, the books are aimed at the informed reader or the enthusiast who is interested in the development history and a not too technical summary of these two British turboprops. The story of each aircraft is most readably told, and the books are a convenient *aide memoire* on the way that Britain got two turboprops into service years ahead of the rest of the world.

In his introduction to the Viscount story, Derek Harvey says "if parts of the story read like an advertising eulogy, it is only because I am as proud of the Viscount as Vickers-Armstrongs and Rolls-Royce must be." Neither volume stints praise for the aircraft under review, and if some of the headaches and mistakes and the painful process of evolving an airliner are glossed over, the difficulties which each has encountered are not omitted. The story of "Operation Gauntlet," mounted by Bristols at Filton to modify Britannia 102s in the light of icing modifications, is well told, as are the vicissitudes which the Viscount suffered before it was ordered by B.E.A.

Both volumes are profusely illustrated, and there are a large number of excellent full-page photographs. The wisdom of including tables of data in a book of this kind—interesting though they are—might be queried; air transport information so quickly becomes out of date. Even at publication the historical accuracy of the volume devoted to the Britannia has suffered by reference to replacement of the Proteus engines with Orions. The publishers have, however, included a press-day footnote saying that the future of this interesting engine "is now uncertain."

With such limitations in mind, it can be said that the published information is commendably accurate and only very occasionally in his description does Mr. Harvey over-simplify the sense. His explanation that zero fuel weight is the "maximum weight at which an aircraft may be landed with empty tanks" strikes an anachronistic note. But settled in the pressurized comfort of one of Britain's turboprop air transports, it is hard to imagine better reading than either of these two books to while away the swiftly passing miles. And at 7¼in by 5in they are of a size which comfortably fits the traveller's pocket.

## AUSTRALASIAN IRONY

THE Australian Government's decision to disallow the import of Caravelles and Electras by T.A.A. and Ansett-A.N.A. respectively (*Flight*, April 11), came as a shock to Australia's domestic airline industry. *Aircraft* of Australia comments: "This writes an abrupt cancellation of a signed contract [with Lockheed] . . . taken against competent managerial and technical advice, it is a retrograde and bad decision which dismays every member of the airline industry." The Australian Government had made plain its belief that, in the interests of the sound economic development of the domestic industry, the Viscount 810-series was the right aircraft.

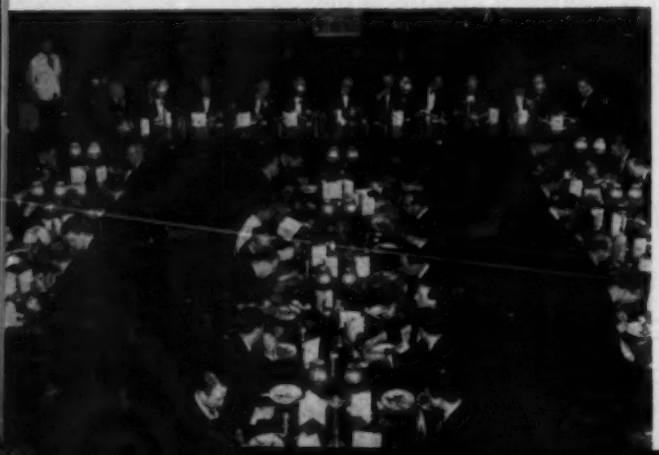
This action by a government is probably without precedent: not even the world's most closely regulated air transport industry—that of the U.S.A.—has ever been refused by the C.A.B. the right to buy the equipment of its choice.

The decision does not apparently affect Qantas' plans to buy five Electras. Qantas is a dollar-earner, which may partly explain why Australia's international carrier will be permitted to buy more American aircraft if it wishes to. But it is significant that not one of the five reasons given by the Australian Government (see April 11 issue) for its refusal of import-licences to T.A.A. and Ansett-A.N.A. was concerned with currency. These reasons made clear the Government's concern with the *domestic* industry's economic progress.

The effect of these developments on the British aircraft industry—when viewed as a whole—appears to be self-cancelling. Vickers may now receive new orders for the Viscount 810; but on the other hand de Havilland appear to have lost what, a very short time ago, appeared to be a certain order for Comet 4Cs. Their potential purchaser was T.E.A.L., whose board is reported to have decided by four votes to two in favour of the Comet for development of N.Z.-Australia (trans-Tasman) and Pacific routes. But T.E.A.L., being 50 per cent owned by the Australian Government, was obviously in a position to integrate its activities more closely with Qantas by purchasing the same medium transports; and no doubt Lockheed will have offered more favourable Electra terms to Qantas on the understanding that they brought T.E.A.L. into the deal also. How this will go down with the New Zealand interests in T.E.A.L. is not clear, but the majority decision in favour of Comets was probably not easily revoked, particularly as there has already been some N.Z. resistance to the Australian partnership in T.E.A.L.

The last has not yet been heard on all these issues: it could still happen that T.E.A.L. will get their Comets, Ansett-A.N.A. their Electras, and T.A.A. their Caravelles. But it seems ironic that a Commonwealth airline which wants new British aircraft has been forced to buy American, while two others who apparently did not want to buy British are being required to do so.

The possibility that T.E.A.L. may now buy Electras does not alter the fact that the airline's first technical choice was the Comet. This is probably small comfort to de Havilland, particularly when American sales pressure elsewhere appears to be jeopardizing another airline's technical decision in favour of the Comet: Aerolineas Argentinas, having decided to buy Comet 4s, are being subjected to heavy pressure from Boeing. Last week that company chose to attempt to sway Argentine opinion in favour of the 720 by holding a press conference in Buenos Aires.



*The scene in the Hall of Oriel College, Oxford, at the dinner which concluded the third R.Ae.S. air transport course. Among those on the top table were Mr. S. N. Grant-Bailey, Prof. John Jewkes, Sir William Hildred, Dr. A. M. Ballantyne, Sir Arnold Hall, Sir Frederick Handley Page, Mr. Henry Marking and Sir Sydney Camm. A report on the course appeared in last week's issue.*

*Low-backed bench chairs make sound sense for short-haul passenger services, and this kind of seating will probably be more and more widely adopted as the airlines move into the era of low-cost mass travel. Here is the 60-seat interior of a Silver City Bristol Freighter 32, recently converted from car ferry duties to meet the British independent's expanding passenger business. It is primarily for operations on the Ferryfield-Le Touquet air segment of the airline's Silver Arrow coach-air-rail service between London and Paris, starting on May 21.*

## CIVIL AVIATION . . .

### K.L.M. FINANCES

BEARING in mind the damage inflicted in Indonesia, K.L.M. has emerged from 1957 in somewhat better financial shape than had been expected. Gross revenue climbed by 15 per cent from Fls.434m to Fls.496m, but as costs increased at the same rate net profit remained substantially unchanged at Fls.23m. Related to revenue, the net profit margin fell from 5.3 to 4.6 per cent (still a remarkably high figure). The level of unit costs remained at 34 pence per c.t.m.

Partly as a result of its experience in Indonesia, the Dutch airline failed to fulfil its threat of overtaking B.O.A.C. and thus becoming, after Air France, Europe's second largest carrier. In both 1956 and 1957 the two rival airlines each produced the same output of ton-miles but B.O.A.C.'s slightly higher load-factors (63 per cent against K.L.M.'s 61 in 1956, and 62 against 60 in 1957) ensured a slight lead in terms of traffic.

B.O.A.C. has not yet published last year's financial results but it is highly unlikely that costs were slashed by the 15 per cent needed to reduce its level from 40 pence per c.t.m. to equal K.L.M. The relatively low-cost national airlines of the Netherlands and Switzerland (and probably of Scandinavia) have now attained cost levels only marginally higher than that of Pan American.

### RED ROTORS

NEW from Russia is the agricultural version of Aeroflot's new Kamov Ka-18 helicopter powered by an Ivchenko A1-14V nine-cylinder air-cooled radial (see picture below). It can carry three or four passengers and is to be used for mail-carrying, freight, geographic survey and so on. Distinguishing feature of the Ka-18 is the co-axial 32.7ft diameter rotor blades, each of which can be detached by two people in five minutes. The structure is a welded steel tube truss with a monocoque tail boom; the fuselage is dural skinned. Empty weight (with V.H.F. radio) is 2,255 lb, gross weight 2,889 lb and payload 440 lb (661 lb maximum). The helicopter is equipped with a 3,000w generator, 10 a.h. battery and single-wire D.C. electrics. Other relevant figures are: length, 23ft; width, 9.2ft; height, 10.9ft; max. speed, 81 kt; cruise speed at 1,600ft, 59 kt; max. range with 39 Imp. gal in two metal tanks, 248 miles, plus 30 Imp. gal long-range tanks, 435 miles. Normal range (20 min reserve), 105 to 124 miles.

# BREVITIES

AS *Flight* goes to press it is learned with regret that on April 21 a United DC-7 flying from Los Angeles to New York collided over the Nevada desert with a U.S.A.F. F-100F. All 42 passengers and five crew on board the DC-7 and the two crew of the F-100F lost their lives.

* * *

After May 3 B.O.A.C. will route two flights a week through Melbourne on their services from London to Sydney.

* * *

Fully qualified flight engineers are to be carried on all jet services operated by PanAm, T.W.A. and American.

* * *

Qantas have acquired Fiji Airways. Capt. R. O. Mant, assistant operations manager Q.E.A., has been appointed manager of the new subsidiary.

* * *

In succession to Mr. Arthur Butler, Capt. Stewart Middlemiss of Ansett-A.N.A. has been appointed chief executive of Butler Air Transport, Ltd. (see page 584).

* * *

Restriction imposed by the Indonesian Government on airspace over Djakarta have led B.O.A.C. and Q.E.A. to suspend services through Indonesia.

* * *

Sud-Aviation plan to deliver the first production Caravelle to Air France during May, and the second in October. By next April Air France and S.A.S. should each have received four.

* * *

The Council of the Air Registration Board announces the issue of the undermentioned *Notices to Licensed Aircraft Engineers and to Owners of Civil Aircraft*: No. 2, Issue 13, March 18, 1958; No. 51, Issue 1, March 18, 1958.

* * *

Western Air Lines have been reported as suggesting that financial difficulties might prevent Continental from taking delivery of all their order for 15 Viscount 812s, and could lead to their first Boeing 707 being leased to United.

* * *

In the photograph showing representatives of Rolls-Royce and Douglas discussing delivery of Conway engines for the American firm's DC-8s (April 11, page 495), the Douglas representative was Mr. T. W. Clyne, and not, as stated, Mr. N. Paschall.

* * *

James W. Austin, president of Northeast Airlines, has been discussing with Vickers the possibility of acquiring most of the 15 Viscount 745s built to Capital's specifications but, owing to cancellation of the original order, never delivered.

Lufthansa have now taken delivery of the last of their four L.1649As. The airline's president, Hans M. Bongers, has recently visited Burbank to inspect the Electra.

* * *

A Heron belonging to Aviacion y Comercio, after swerving to avoid collision with another aircraft, descended into the sea off Barcelona on the evening of April 14. There were no survivors among the 14 passengers and two crew on board.

* * *

Boeing have appointed the Babb Co. of New York to sell the 14 Stratocruisers bought back from B.O.A.C. The Babb Co., which holds a controlling share in Transocean Airlines, has already acquired a number of aircraft from B.O.A.C.'s L.079 fleet.

* * *

To obtain extra capacity, Aer Lingus have leased two Viscount 745s from Vickers (these aircraft were until recently operated by Capital Airlines) and have arranged a series of regular charter flights, using Transair's Viscount 804, on the service between Dublin and London.

* * *

American Airlines have advanced their target-date for the introduction of Boeing 707 services by three months. Coast-to-coast jet services should begin before the end of this year, by which time "up to six" 707s will probably have been delivered. American Airlines also expect to begin Electra services before the year is out.

*Latest of a ten-year line of Russian co-axial utility helicopters is the Kamov Ka-18. This model is now in quantity production. (See col. 2.)*

*Agricultural double: (left) the first EP.9 to be sold in South Africa being handed over by freelance delivery pilot Beverley Snook to Dr. G. Jaaback of Lush Products, Ltd., at Durban, after en route demonstrations at Nairobi, Beira, Salisbury and Johannesburg. (Right) This Piper PA-18A Super Cub, operated by Farmair, Ltd., arrived at Panshanger last month and is used for agricultural work.*

# CLUB AND GLIDING NEWS

AN international air rally, to be held at Shoreham Aerodrome during the week-end May 29-June 1, is being organized by the Royal Aero Club. Aircraft are expected to arrive on the afternoon of Thursday, May 29, and the week-end's activities will include visits to Arundel Castle, Cowdray Park and London, and a banquet and dance at the Grand Hotel, Brighton. Customs facilities will be available at Shoreham. Application forms and regulations for the rally are obtainable from the Air Touring department of the Royal Aero Club at Londonderry House, 19 Park Lane, London, W.1.

THRUXTON Aerodrome, near Andover, is to be sold by auction (on behalf of the Air Ministry) at the end of June, planning permission having been obtained for its continued use as a civil aerodrome. Originally purchased as Thruxton manor estate by the Air Ministry in 1940, Thruxton was opened as an airfield in May, 1941, for use by Army co-operation squadrons of the R.A.F. Many squadrons, formed and trained there, worked closely with the Airborne Division in glider-towing and paratrooping operations from the airfield until the end of the war. The U.S. Air Force occupied Thruxton in the spring of 1944 and, when no longer required for military use, the site was leased to the Wiltshire School of Flying in 1946. This organization has operated at Thruxton since that date, and its lease will continue after the sale of the aerodrome. It is possible that the Wiltshire School may purchase the aerodrome section of the site (additional agricultural land is also included in the sale).

A PRENTICE is being evaluated for club use by the Surrey Flying Club at Croydon, and is being operated at a flying charge of £7 per hour. Other news from the Surrey club is that its aircraft are now being serviced by A. G. Whittemore (Aeradio) Ltd.; that Mr. Alan Sproxton, one of the founders of the club, has resigned from active instructing for health reasons; and Mr. Alfred Westaway has joined the instructional staff. The date of the club's anniversary and Redhill reunion party will be Saturday, May 10.

THE 1958 flying programme of the Women's Junior Air Corps began during the Easter week-end with flights for Surrey and London cadets in the Corps' Messenger G-AKXC *Grey Dove 3* at Croydon. Other aerodromes at which the Messenger will be flying this month include Shoreham, Southend, Ramsgate, Lympne, Kidlington, Old Warden and Luton. Mrs. Joan Grimaldi has resigned as aviation adviser to the Corps (in order to qualify for her Senior Commercial licence) but remains as pilot for this season's flights. Miss Hazel Prosper is now dealing with the administrative work as aviation officer.

TEN years' flying at Denham by D. C. G. ("Wilbur") Wright, C.F.I. of Denham Flying Club, were marked by a party given last month on behalf of the aerodrome owners by Mrs. E. Bickerton. A variable circuit is now in operation at Denham, with the object of reducing the noise nuisance to residents of Gerrards Cross.

RECENTLY affiliated to the Popular Flying Association is the Tiger Club, whose fleet consists of Tiger Moths, Hornet Moths, Jackaroo, Arrow Active and Turbulent.

VISITS to aircraft manufacturing companies are a feature of the current programme of Exeter Aero Club. Following a visit to the Bristol aircraft and engine factories at Filton last month, the club has been invited to see the Westland facilities at Yeovil on April 29.

A FOUR-SEATER version of the Italian Falco touring aircraft is expected among the varied selection of some 30 machines at Kidlington Airport, Oxford, this week-end (April 26-27) at the sales meeting organized by W. S. Shackleton, Ltd.

POLAND'S preparations for the World Gliding Championships at Leszno in June include the setting-up of a "village of tents" on the airfield for the accommodation of pilots and crews; and the provision of an increased number of Polish gliders for foreign contestants. A total of 29 countries have now indicated their intention to participate: they are South Africa, Argentina, Australia, Austria, Belgium, Brazil, Bulgaria, Czechoslovakia, Denmark, Finland, France, Spain, the Netherlands, Israel, Japan, Jugoslavia, Canada, Luxemburg, Norway, Federal Germany, New Zealand, Rhodesia, Rumania, U.S.A., Sweden, Turkey, Hungary, Great Britain and the Soviet Union. The OSTIV congress (June 19-28) will be held at Osieczna, nine miles from Leszno.

THE Duke of Edinburgh is to receive the members of the British team for the World Gliding Championships at Buckingham Palace on Thursday, June 5, prior to the departure of the team for Poland. Prince Philip is the Patron of the British Gliding Association.

FIRST flight of the vee-tailed Bréguet 905 Fauvette glider (illustrated in our issue of March 7) took place successfully on Tuesday, April 15. Designed and built in only four months, this aircraft conforms with the specifications of the F.A.I. standard class, and presumably may make its international debut at the Leszno championships.

IN addition to the outstanding glider flights reported in last week's issue, the week-end of April 12-13 produced a number of other notable achievements. These included a Gold C distance flight of 189 miles from Lasham to a point near Perranporth, Cornwall, by Frank Irving in a Skylark 3 on Saturday, April 12; and a flight of 148 miles from the Derby and Lancs. site at Camphill to Rhoose Airport, Cardiff, by Bill Ellrington in a Sky on April 13. The flight by John Westhorpe from Dunstable to Plymouth (reported last week) qualified him for his Gold C distance and goal diamond only two weeks after he had achieved his Silver C distance. He is a new course instructor at the London Gliding Club.

CAMPHILL, Detling, Dunstable, Nympsfield, Portmoak and Sutton Bank (it is now confirmed by the British Gliding Association) will be the six sites for the National Gliding Week from July 27 to August 9. A total of between 80 and 100 entries are expected.

A NEW theory of the structure of thermals will be outlined by Miss Betsy Woodward, the U.S. glider pilot now at Imperial College, in a talk at the Kronfeld Club on Thursday, May 1.

THE twelfth annual general meeting of Bristol Gliding Club—the first to be held in the new clubhouse at Nympsfield—was held on Saturday, March 29. The club chairman, Mr. John Cochrane, reported that 1957 had been the most successful year in the history of the club. Totals of 6,760 launches and 1,250 flying hours had been achieved, and the cross-country distance flown was 3,600 miles. Among the year's most notable flights were the 188 miles to Land's End by Derek Stowe in the club Olympia, and the series of flights made by Peter Scott and Peter Collier in Mr. Scott's T.42 Eagle. This machine, the chairman recalled, had been used to give the Duke of Edinburgh his first glider flight, made with Peter Collier from Nympsfield in May. Committee members elected for 1958 were John Cochrane, chairman; Alwyn Sutcliffe, vice-chairman; Tom Parkes, secretary; Alan Smith, treasurer; Doug Jones, Ron Clarke, Gordon Fisher, Mike Hodgson, Pete Etheridge and Mike Garnett, committee members. Mr. Jones continues as ground engineer at the club for the ninth successive year. Aircraft currently based at Nympsfield comprise one T.42 Eagle, three Skylark 2s, three Olympias, two Tutors, a Prefect, T.21, T.31, Kite 1 and Kite 2.

# SERVICE AVIATION

*Royal Air Force and Naval Flying News*

### Showing the Flag

TWO Vulcans of No. 83 Sqn. and a Comet 2 of No. 216 Sqn, are due to leave the U.K. today (April 25) for the Argentine to take part in ceremonies marking the installation of Dr. Arturo Frondizi as President of the Republic on May 1. This will be the first time Vulcans have been seen over South America.

The Comet is carrying Mr. George Ward, Secretary of State for Air, who has been appointed by the Queen as her special ambassador for the occasion. Two Hastings of No. 24 (Commonwealth) Sqn. will carry ground crews and equipment, and the force will consist of a total of 70 air and ground personnel,

Commanding the force will be Air Marshal G. A. Walker, A.O.C. No. 1 Group, who is flying as co-pilot in one of the Vulcans. The deputy commander is G/C. S. L. Ring, C.O. of R.A.F. Waddington.

### Duncan Trophy Award

AWARDED annually for the most accurate air firing by R.A.F. fighter squadrons in 2nd T.A.F., the Duncan Trophy has been won for 1957 by No. 118 Sqn., which was recently disbanded. Air Marshal Sir Humphrey Edwardes Jones, C-in-C. 2nd T.A.F., was to present the trophy to the squadron's former C.O., S/L. N. C. Buddin, at R.A.F. Jever on April 22.

### Beverley Utilization

IN a lecture on *The Beverley in Service*, given before the Brough branch of the R.Ae.S. on April 2 (coinciding with the end of the aircraft's second year of R.A.F. operation), the C.O. of R.A.F. Abingdon, G/C. F. C. Griffiths, said that "despite its slow flying speed and extraordinary shape" the Beverley had proved itself very popular with the Army and with the R.A.F. Emphasizing that the opinions expressed were purely his own and not those of Air Ministry or Transport Command, G/C. Griffiths suggested that the introduction of such a large freighter aircraft might have a far-reaching effect on the size of stores depots overseas and in some cases on the necessity for having them at all.

During the first year of freight operation from Abingdon, 10½ million pounds (4,700 tons) and 2,763 passengers had been moved. The Beverleys were used for casualty evacuations from the Middle East (though in this rôle were not highly successful, partly owing to their high noise level), on the Hungarian refugee airlift, and in the Suez operation. In the autumn of 1956 the longest flight so far was carried out—from Aden to El Adem in 14 hr 40 min, at 1,800 r.p.m. and an I.A.S. of about 123 kt. But it had been found that at such a low airspeed the aircraft could only be flown in really calm conditions.

In Aden operations Beverleys had distinguished themselves by operating into small airstrips at high altitudes. During last year both heavy dropping techniques and transport support training had been successfully carried out, and the Beverleys were used on a mobility exercise between Abingdon and Dishforth, on a Parachute Brigade drop in Denmark as part of NATO exercises, and in the Oman operations. Early this year they participated in Exercise Quickstep, moving advance elements of 24 Brigade to Tripoli; though the planned flying times of eight hours (outbound) and eleven hours (homeward) "brought out our vulnerability in high winds and at low air speeds," said G/C. Griffiths. Finally he mentioned the Beverley's first appearance —early this year—in F.E.A.F., where it was used on anti-terrorist operations.

### Anniversary Exhibition

A FLY-PAST by Hunters of No. 74 Sqn. and a Valiant from No. 214 Sqn. marked the opening of an exhibition held in Norwich from April 11 to 19 to commemorate the 40th anniversary of the R.A.F. Among the exhibits were a D.H. Firestreak and Vampire T.11. The exhibition was arranged by F/L. T. Lockwood, who is O.C. No. 49 Recruiting Centre.

### R.C.A.F. Awards

FOR their part in rescuing two fishermen from a sinking vessel off the west coast of Canada, two members of the R.C.A.F., F/L. A. G. Carswell and Sgt. I. J. McPherson, have been awarded the A.F.C. and B.E.M. respectively. F/L. Carswell receives the award for "courage and airmanship" in the handling of his Canso aircraft in heavy seas and Sgt. McPherson for "utter disregard for his own safety in climbing out on to the pitching wing to effect the rescue."

### Forthcoming Reunions

THE **Polish Air Force 9th Bomber Reunion** will be held at the Polish Air Force Association headquarters (14 Collingham Gardens, London, S.W.5) on Saturday, May 10, at 3 p.m. Members of the R.A.F. who served during the last war with Polish bomber squadrons are cordially invited to attend.

* * * * *

This year's annual dinner of **No. 601 (County of London) Sqn., R. Aux.A.F.**, will be held at The Windsor Castle, Vauxhall Bridge Road, London, S.W.1, on Saturday, May 10, at 6.30 for 7.30 p.m. Tickets (price 15s. 6d.) are obtainable from H. R. Cooke, Esq., 43 Crown Rise, Garston, Watford, Herts.

* * * * *

The twelfth annual reunion of **No. 619 Sqn.** is again being held at the "Magpie and Stump," 18 Old Bailey, London, E.C.4, and will be on Saturday, May 10, at 7-7.30 p.m. Applications for tickets (12s 6d each) should be addressed to P. S. Osborne, Esq., Bernard Works, Sylvester Gardens, Sheffield, 1.

*Lt-Col. E. Tuster, Norwegian Air Attaché (left), presenting to the C.A.S., Marshal of the R.A.F. Sir Dermot Boyle, at Air Ministry recently a glass bowl bearing the Royal Norwegian Air Force badge and inscribed with the words "To the Royal Air Force on their 40th anniversary, 1 April 1958."*

### IN BRIEF

G/C. Rudolph T. Taaffe has succeeded G/C. A. ap Ellis as secretary of the Republic of Ireland branch of the R.A.F. Benevolent Fund.

* * * * *

Two Indonesian Air Force officers recently arrived in this country to take a course at the R.A.F. Staff College, Andover.

* * * * *

At pay parades on April 17 airmen and airwomen received for the first time the higher rates announced on February 13.

* * * * *

The fifth annual service of commemoration at the Runnymede Memorial, Cooper's Hill, Egham, will be held on Tuesday, May 13, at 3.15 p.m.

* * * * *

The R.A.F. Benevolent Fund has announced that with the addition of £451 received last month the total from 1957 Battle of Britain Week activities by R.A.F.A. branches is now £14,015.

* * * * *

Six members of No. 408 Sqn., R.C.A.F., have been "on location" at Cambridge Bay in the Arctic acting as survivors from a crashed aircraft for a new survival training film being made jointly by the R.C.A.F. and the Canadian National Film Board.

* * * * *

Eight S.A.A.F. officers have been undergoing what has been described as the "toughest" survival course yet held by the South African Air Force. It has included fending for themselves in lonely bushveld near the Limpopo River and being left in dinghies in the Hartbeespoort Dam with only essential survival equipment.

* * * * *

A tie has been designed for exclusive wear by officers and airmen who are serving or have served with No. 1 Group, Bomber Command. Its design consists of panthers' heads (the No. 1 Group crest) in silver on a Lincoln green background. These ties (22s 6d silk, 15s 6d rayon) may now be obtained from Gieves, Ltd., 27 Old Bond Street, London, W.1.

*The two D.H. Herons, XM295 and XM296, recently delivered to the Queen's Flight (which now has three) at R.A.F. Benson. They are polished, with a royal blue flash picked out in red.*

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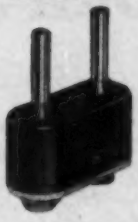

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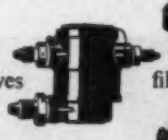

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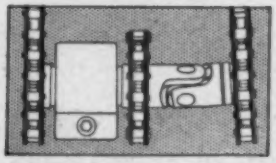

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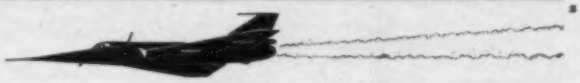

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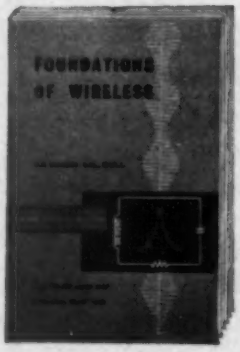


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THE AIR TRANSPORT ADVISORY COUNCIL give notice that they have received the undermentioned applications to operate scheduled air services:—

APPLICATION No. 324/1 from B.K.S. Air Transport, Ltd., of 1 Marylebone High Street, London, W.1, for permission further to integrate the services approved under Applications Nos. 324 and 470 which may presently be combined so as to provide a service on the route Leeds-Ostend-Dusseldorf with traffic rights between Leeds and Ostend and between Leeds and Dusseldorf only, so as now to enable them to exercise traffic rights also between Ostend and Dusseldorf.

APPLICATION No. 1672 from British Overseas Airways Corporation of London Airport, Hounslow, Middlesex, for permission to include an optional traffic stop at Tripoli on the normal scheduled services operated on reserved routes Nos. 11 and 12 as set out in Schedule "A," Part I, of the terms of reference issued to the Council by the Minister of Civil Aviation on July 30, 1952, and also on the routes approved under Applications Nos. 57 (London-Dar es Salaam), 62 (London-Lusaka and/or Salisbury) and 360 (London-Nairobi).

THESE applications will be considered by the Council under the terms of reference issued to them by the Minister of Civil Aviation on July 30, 1952. Any representations or objections with regard to these applications must be made in writing stating the reasons and must reach the Council within 14 days of the date of this advertisement, addressed to the Secretary, Air Transport Advisory Council, 3 Dean's Yard, London, S.W.1, from whom further details of the applications may be obtained. When an objection is made to an application by another air transport company on the grounds that they are applying to operate the route or part of route in question, their application, if not already submitted to the Council, should reach them within the period allowed for the making of representations or objections. [7805

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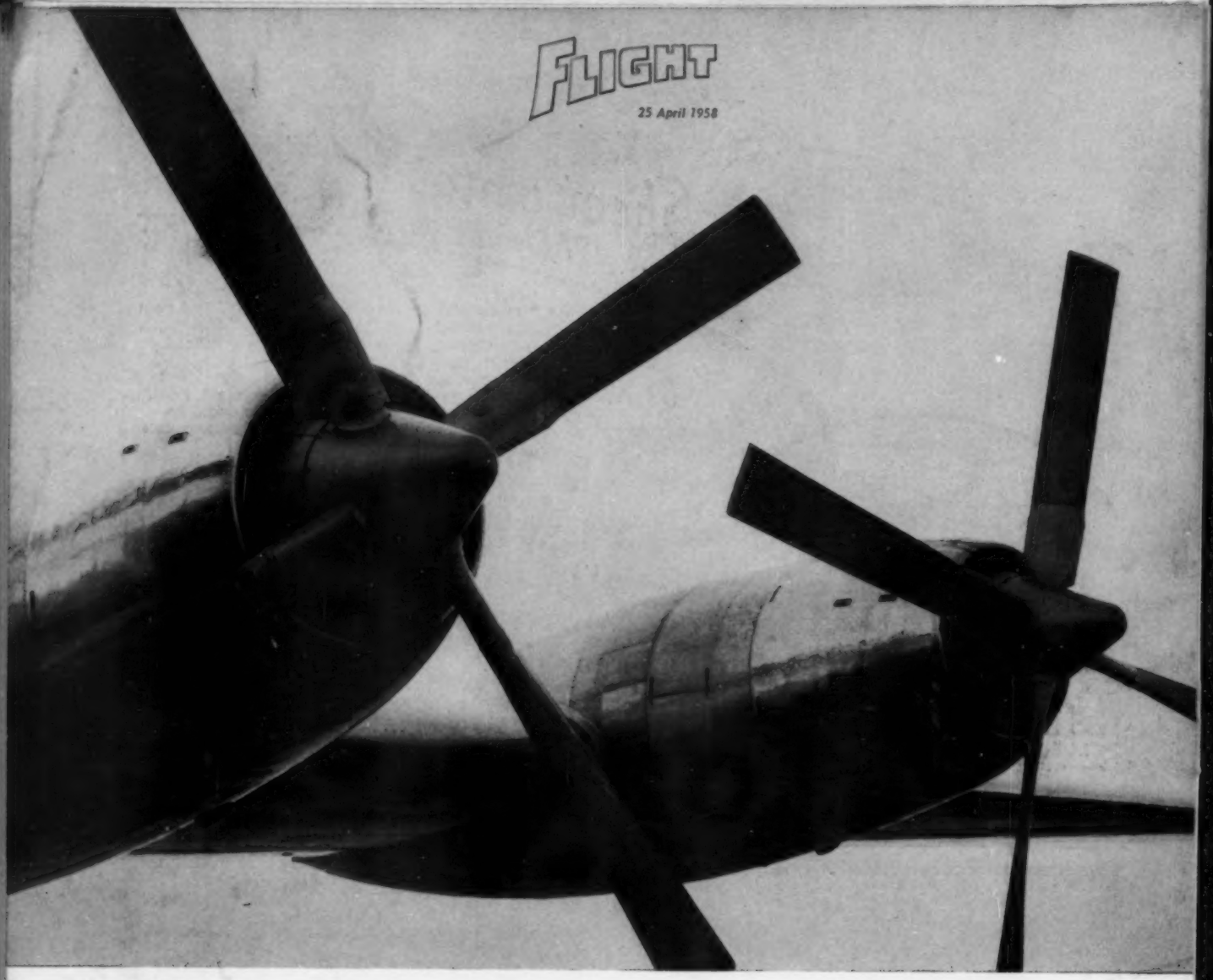

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